NAVPak-4 User Manual

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1 Changes Overview

Welcome to the new version of NAVPak-4RT.

This version of NAVPak-4RT has introduced a number of new features to enhance the operability of the software, visual indicators,

1.1 Alarm States

The alarms benefit from the introduction of transitory and latched warning states. Each alarm shows the “current state” of the BIT to the left of the alarm text. If a fault continues past the designated latching time the alarm will latch and therefore will require the operator to acknowledge the fault before the system shows as being clear.

1.2 Traffic light

The traffic light has been redesigned to only display a fault on the failure of the DNAV output or the primary position exceeding the HAA thresholds. The traffic light has also been modified to show current alarm states rather than alarms that have occurred.

1.3 Introduction of the graphics panel

The graphics panel introduces visual displays of the HAA, satellite geometry and the attitude (pitch, roll and heading)

1.4 BIT structure

The BIT information has been structured into separate panels so not to overload the screen. The side menu provides access to the BIT information and displays the latched and transitory warnings associated with each. The panels have developed in a way to allow the operator to navigate through to find faults quickly.

1.5 Logged data filenames

The following changes have been applied to NAVPak-4RT quality control data files.

- Each filename three-letter-suffix has changed (e.g. "filename.POS" where "POS" is the suffix). This ensures that NAVPak-RTv3 data files are distinguishable from files created with NAVPak-RTv2 and earlier. The internal file-format has been changed in v3 to match that used by NovAtel.

- The change in file-format is to facilitate analysis of the files using tools other than NavPak-PP and to allow files to be submitted directly to NovAtel. This makes fault finding easier as the files will not need to be converted first.

- In some cases, different log files have been used this is to make use of the newer OEM-V3 card. For example the NovAtel SATVIS log is used instead of GPGSV for the sky-

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view.

- New logs from the SPGR are now stored to provide information that was not available in NAVPak-RTv2 and earlier. The new version of the PP software that accompanies NAVPak-RTv3 will be able to cope with all NAVPak file-formats.

- The filenames have been changed in order to allow easy identification by operators and support staff. As an example: An operator might want to examine data collected on 27th July 2008. The new file format shows the data file as 2008_07_27 which is easier to identify than calculating the Julian day.

- The use of hours, minutes and seconds within the filename means that the old method of using "spinners" is no longer required. The spinner file format ensured that no files where overwritten and this has now been replaced due to the unique time stamp.

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2 Introduction

2.1 Scope

The manual has been developed as one part of a two manual set, describing, in this case, the NAVPak-4 software and another manual describing the optional CPUPak-4 system. For information about the CPUPak-4 environmental standards, electrical parameters and connectivity please refer to the CPUPak-4 Operators Manual.

Additional documentation is supplied by NovAtel which details the GPS devices and peripherals in greater detail than necessary for the operation of NAVPak-4. If operators read these manuals they will become aware of a far greater range of functionality available for the receivers and not currently used to meet this requirement.

This extra functionality can be accessed through the auxiliary serial port or USB ports

2.2 Purpose of NAVPak-4 and CPUPak-4

The NAVPak-4 software suite has been developed with the aim of letting the user assess quality and integrity of navigation data in an easy, intuitive manner.

2.2.1 Navigation Strategy

CPUPak-4 utilises two GPS receivers and two different antenna types at all times to monitor position accuracy and system integrity. The two receivers, a NovAtel dual-frequency OEMV and a Rockwell SPGR P/Y code unit complement each other in performance and positioning integrity. The antenna are a Raytheon CRPA anti-jamming antenna and a NovAtel 600LB “Pinwheel” unit

Rockwell’s SPGR P/Y code receiver has the ability to navigate either from L1 or L2 using C/A or P and Y codes. In a hostile jamming and spoofing environment the SPGR and the CRPA antenna will always give a position whereas the NovAtel unit that complements it will possibly not be able to. The NovAtel unit complements the Rockwell SPGR’s robust positioning with a highly precise position capability through specially tailored “advanced” signal processing

Raytheon’s CRPA antenna has the capability to detect and eliminate C/A, P and Y code jamming from the received signal while NovAtel’s 600LB has a precise phase centre that receives not only L1 and L2 C/A signals but also L band differential GPS broadcasts.

The combination of receivers and antenna give several modes of positioning allowing the CPUPak-4’s software, NAVPak-4, to make any two statistical and redundant assessments while automatically controlling the overall system operation. From the users perspective this offers a greater probability of quality positioning at all times. There is no need to question system integrity as much with two receivers as long as they are in agreement. With respect to hardware the NovAtel receiver will work deeper into signal jamming and spoofing environments using the CRPA antenna while the SPGR gains the benefit of comparative performance assessments with respect to a survey class satellite navigation receiver.

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From a navigation and survey point of view the capability of having two separately computed positions is very useful. The two positions are computed by different algorithms from raw data gathered by two different signal processing regimes. However the two positions are then accepted/rejected and qualified based upon an identical set of internationally accepted statistical measures. This is invaluable because we can now assess positioning performance on a common basis.

So in summary the navigation strategy is to employ two navigation methods, not one, using different navigation algorithms and hardware with a choice of antenna to compute two independent positions. By statistically assessing and comparing the two positions and quality data using common statistical algorithms the user can then gain an additional level of confidence in the navigation accuracy and quality that far exceeds the sum of the two separate parts. To make it easy for the user the NAVPak-4 software reduces navigation to a “traffic light” concept where “green” means everything is OK, “amber” is a cautionary condition and “red” is an unacceptable condition. However the supporting information to make this red, amber, green decision is present and ready for inspection so the qualified user can understand the decision.

2.2.2 Hardware Strategy

CPUPak-4 and NAVPak-4 make great use of the built-in-test capability of the GPS receivers so that fault finding is easy to understand and report with little understanding other than to switch on and run the system. Again NAVPak-4 runs extensive tests on the hardware to measure voltages, temperatures, currents, as well as a host of flagged conditions to determine if the hardware is OK. In the event that a test is failed or a limit exceeded the traffic light concept is used to warn the user.

2.2.3 Fault Reporting & Data Analysis

Fault reports are generated and logged to a dedicated folder for each Julian Day. Also logged is default BIT and Quality data at regular intervals of between one second and one hour. Examination of associated data will quickly let the user see relationships leading to fault or cautionary conditions. Faults can be traced to circuit board components with an audit trail so decisions on whether it’s the GPS receiver, the antenna, the power supply or the CPU causing a problem can be accurately reported and the correct spare installed with a high probability of success.

The software is able to analyse all manner of aspects with relation to navigation data quality such as individual satellite signal strengths, satellite signal lock-times, signal noise, Doppler frequencies, satellite pseudorange residuals, standard deviations, error ellipse, F-Test, W-Test, etc… All of this data is collected, can be analysed and is reduced to the “traffic light” notification system so that the user reliably knows the condition and status of the CPUPak-4 navigation system.

2.3 Prerequisites

The Forsberg Services Limited (FSL) NAVPak-4 operates in a real-time environment, and to that end can use a Windows 98, NT, XP, 2000 or CE operating system. The NAVPak-4RT software is designed to start-up automatically and configures the peripheral devices.

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To ensure smooth and successful operation the following conditions are to be met prior to powering up the CPUPak-4:

1. By reference to the CPUPak-4 Users' Manual ensure all connections are made in the correct manner.
2. Ensure all optional devices external to the CPUPak-4 are powered up and ready to provide data e.g. the Rockwell SPGR and Mk12 gyrocompass in some configurations.
3. Having achieved 1) and 2) correctly, run the NAVPak-4 software and wait for around forty-five seconds for full messages to be generated. The action of configuring the CPUPak-4 receiver can cause a reset necessitating a full sky search for satellites.
4. Only the NAVPak-4 application program is to be run on the processor and at no time may other software be run that attempts to communicate and send conflicting commands to the NovAtel receiver or com ports.

2.4 Installation

The NAVPak-4 software is loaded to the selected mass storage media. In the event that the software needs reloading take the following action.

1. Before proceeding any further, ensure that you have a back-up copy of the software rather than working from the master copy.
2. Insert the back-up copy in the computer transfer drive.
3. Open up Windows Explorer on the external PC.
4. Copy all data from the NAVPak-4 C:\ directory to a backup directory on the external computer
5. Access the NAVPak-4 master directory for NAVPak-4. This is C:\
6. Clear the onboard directories completely.
7. By using Windows Explorer copy a complete new copy of NAVPak-4 and its supporting operating system to the C:\ drive, or similar, on the computer.
8. Create a shortcut for the NAVPak-4 executable file and place it on the "desktop."
9. Click on the shortcut and your new copy of NAVPak-4 should now be running correctly.

2.5 Starting NAVPak-4

NAVPak-4 should start automatically on system start up. If the software fails to load navigate to C:\NAVPak-4 and open the NAVPak.exe file.

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3 NAVPak-4 Software

3.1 Main screen

The NAVPak-4 main screen is shown below. This will be the default display that is shown on start-up.

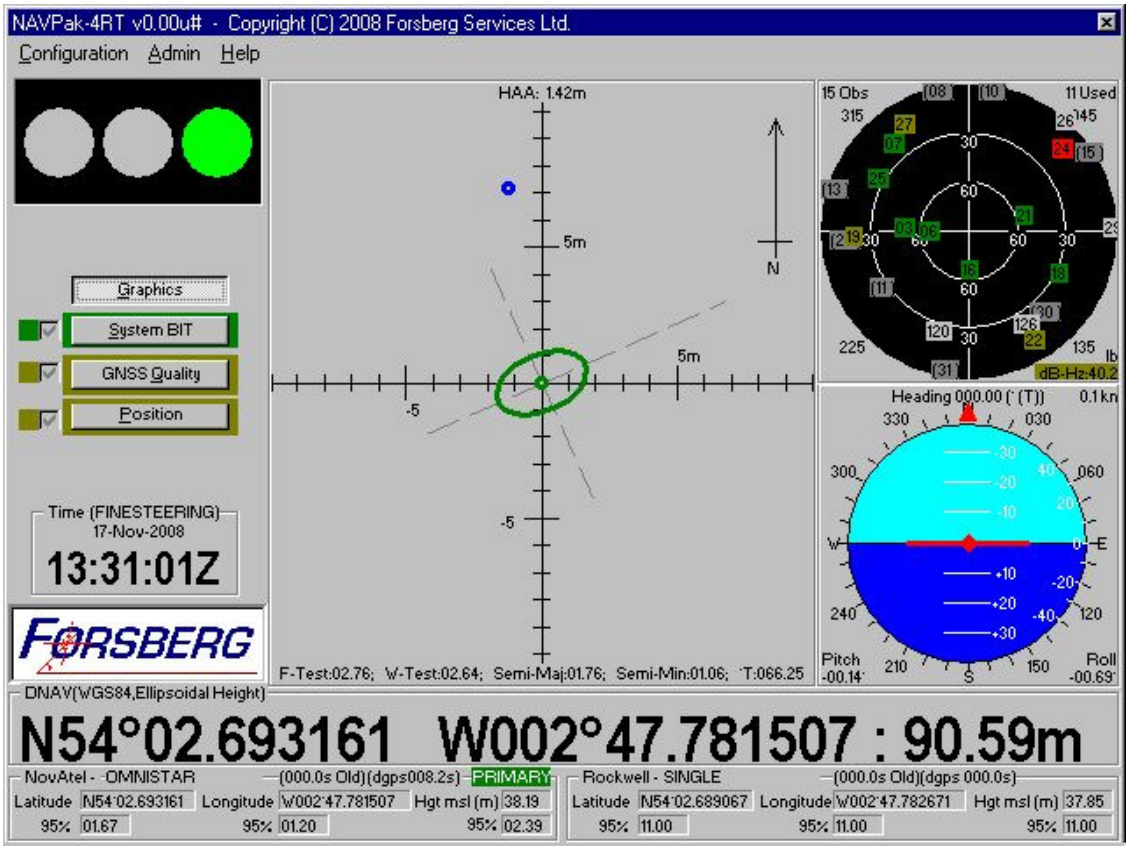

Figure 1 NavPak-4RT

3.1.1 Configuration/ Admin Menu

The configuration and admin menu provides access to the configuration and administration settings for the software such as the alert thresholds and corrections.

3.1.2 System Status

The system status is a traffic light system that displays the current state of the system position as represented by the **B**uilt **I**n **T**est (BIT). The system status traffic light can be clicked to open the log of errors and acknowledge and alarms. Alternatively ‘F6’ will short-cut to the error log.

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3.1.3 Graphical display

A new feature to this version of NAVPak-4 is the introduction of graphical displays to represent the error ellipse, satellite geometry and attitude data. The display consists of three panels, one main and two sub panels. When the graphics option is selected, each sub panel can be swapped into the main panel simply by clicking the sub-panel.

The display menu on the left of the screen is used to change the information displayed in the main panel. The menu provides access to the BIT screens which contain specific system information. Each button has its own transitory and latched status indicator to display alerts relevant to the associated BIT.

3.1.4 Date & UTC Time

A display of the date and UTC time as read from the primary GPS receiver. UTC time has a variable offset in whole seconds from GPS time.

3.1.5 Output Position

The WGS84 position and ellipsoidal height of the primary receiver as output in the DNAV message. When lever arm offsets have been added to the system this position will be corrected.

3.1.6 NovAtel GPS Position

The WGS84 position and Mean Sea Level (MSL) height of the NovAtel GPS receiver. The MSL height is derived from a scaled down version of the OSU89B model on a 1 x 3 degree grid. The MSL value shown will show some variance from the actual MSL value in your locality. It is important that this height is noted as being significantly different in most locations to WGS84 ellipsoidal height.

3.1.7 Rockwell GPS Position

The WGS84 position and Mean Sea Level (MSL) height of the Rockwell GPS receiver. The MSL height is again derived from a model defined by the Defence Mapping Agency. The MSL value shown will show some variance from the actual MSL value in your locality. It is important that this height is noted as being significantly different in most locations to WGS84 ellipsoidal height.

3.2 Colour schemes

NAVPak-4 uses three colours throughout the software to indicate status.

RED – The system is in or has experienced an unacceptable condition.
AMBER – The system is in or has experienced a cautionary condition
GREEN – The system is OK.

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3.3 System Status and Error States

3.3.1 Traffic light

The traffic light is used to show any current alerts for the system. The traffic light will only display positional alerts that are occurring and will not show latched errors. Latched errors are those errors which have continued for more than a period of time set by an “Expert User.” Conversely other errors can be called transitory. When an error is in a transitory warning state it is displayed through the traffic light. The transitory warnings are displayed beside the menu buttons for the associated BIT and each individual alarm.

To open the log of errors double click on the traffic light. This will display the errors that have occurred in the system and the time stamp of their occurrence. After reading the errors they can be acknowledged by selecting “Acknowledge” or “Acknowledge All” to remove the need for doing each in turn.

3.3.2 Transitory warning/ current state

The current state of an alarm is represented using a coloured box to the side of the alarm or menu button. During a transitory alarm the box will colour to indicate the state of the equipment.

When an error occurs it will remain in a transitory state for 10 seconds (default) before becoming a latched state. A transitory state is used as some errors may be caused very briefly and therefore do not require immediate attention. When the error becomes latched they require attention form the system administrator.

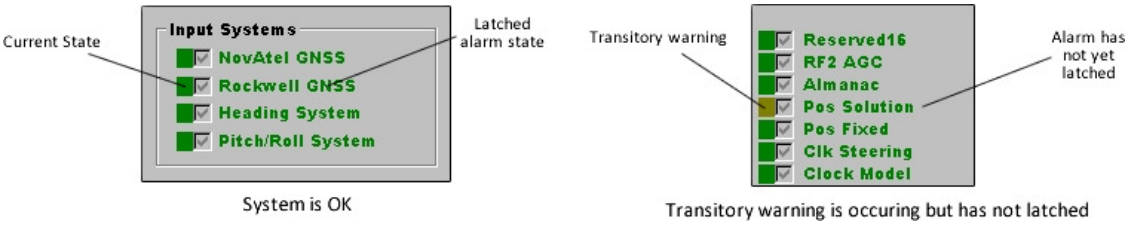

Figure 2 Transitory alarm states

The figure above shows an example of a transitory warning that has not latched.

3.3.3 Latched errors

A latched error will occur once a warning has been flagged consistently for more than 10 seconds (default). Once latched, the error will require acknowledging before it is cleared. A latched error is shown by the applicable field text turning amber or red. Before acknowledging the error the source of the error should be investigated and fixed. When the fault is no longer occurring the transitory warning will disappear and turn green. At this point the error can be acknowledged either by clicking the alarm text or through the traffic light. A latched alarm can always be acknowledged. However it may latch again once acknowledged if the condition has not gone away.

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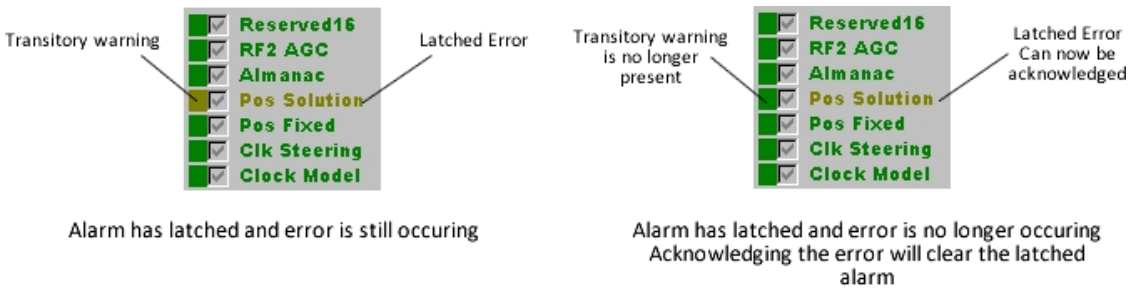

Figure 3 Latched alarm states

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3.4 Time

The time is taken from the primary navigation receiver which may be a NovAtel OEMV or Rockwell receiver. GPS time and receiver status are also shown. The time status for the OEMV has some useful information to enable the user to understand the time quality. The following explains how the NAVPak-4 system arrives at it's time statements:

All reported receiver times are subject to a qualifying time status. This status gives you an indication of how well a time is known. There are several distinct states that the CPUPak-4 will go through:

- UNKNOWN
- COARSE
- FREEWHEELING
- FINE
- FINESTEERING

On start up, and before any satellites are being tracked, the receiver cannot possibly know the current time. As such, the receiver time starts counting at GPS week 0 and second 0.0. The time status flag is set to UNKNOWN (this results in an unusual set of data files representing day 0 to 366).

Upon receipt of the first RTCAEPHEM message the time status will be APPROXIMATE.

After the first ephemeris is decoded, the receiver time is set to a resolution of ±10 milliseconds. The COARSE or COARSESTEERING time status flag depending on the state of the CLOCKADJUST switch qualifies this state.

Once a position is known and range biases are being calculated, the internal clock model will begin modeling the position range biases and the receiver clock offset.

Modeling will continue until the model is a good estimation of the actual receiver clock behavior. At this time, the receiver time will again be adjusted, this time to an accuracy of ±1 microsecond. This state is qualified by the FINE time status flag.

After further refinement and if CLOCKADJUST is set to ENABLE (default for CPUPak-4), then the receiver will start to steer the onboard clock to minimize the receiver range bias. This condition is qualified as FINESTEERING and will result in timing accuracies of around +/-100 nanoseconds RMS in stand-alone mode and +/-20 nanoseconds RMS in DGPS mode. If Selective Availability were to be switched on again expect the stand-alone timing accuracy to degrade to a level around +/-250 nanoseconds RMS.

In summary the following statements may be seen on the CPUPak-4 display

UNKNOWN - Time validity is unknown.
APPROXIMATE - Time is set approximately.

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COARSEADJUSTING - Time is approaching coarse precision.
COARSE - This time is valid to coarse precision.
COARSESTEERING - Time is coarse set, and is being steered.
FREEWHEELING - Position is lost, and the range bias cannot be calculated.
FINEADJUSTING - Time is adjusting to fine precision.
FINE - Time has fine precision.
FINESTEERING - Time is fine, set and is being steered.

In the case of the Rockwell SPGR receiver when UTC is selected, the time will be within ±100 ns of UTC 1 second rollover when the Time Figure of Merit (TFOM) is 3 or less. The receiver outputs TFOM values that relate to precision shown in the table below.

TFOM Value	Estimated Time error
1	≤ 1 nsec
2	> 1 nsec ≤ 10 nsec
3	> 10 nsec ≤ 100 nsec
4	> 100 nsec ≤ 1 µsec
5	> 1 µsec ≤ 10 µsec
6	> 10 µsec ≤ 100 µsec
7	> 100 µsec ≤ 1 msec
8	> 1 msec ≤ 10 msec
9	> 10 msec

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3.5 Position Information

3.5.1 Output position

The output position is the WGS84 position and ellipsoidal height as output through the DNAV message. The text will change to amber or red to show the current state of the DNAV message and if there are any cautionary affects on the DNAV position. When the system is ok the text is black. This position is lever arm corrected.

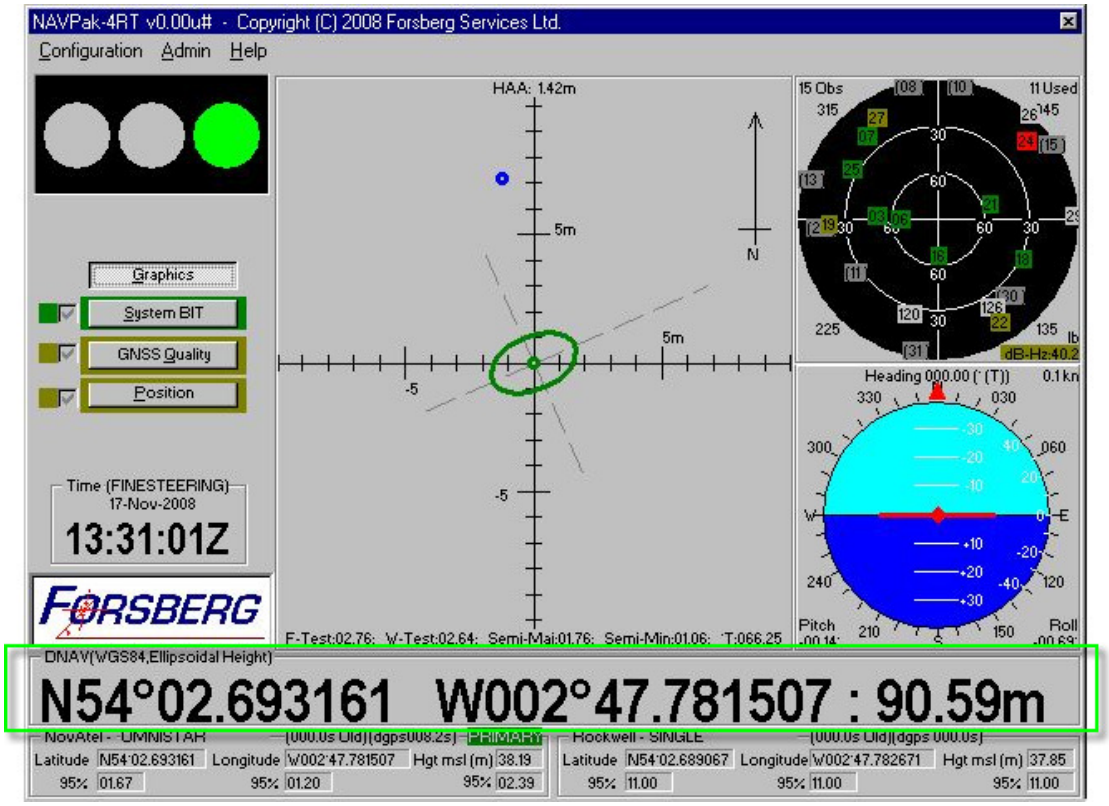

Figure 4 NAVPak-4 with DNAV Output display

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3.5.2 NovAtel GPS receiver

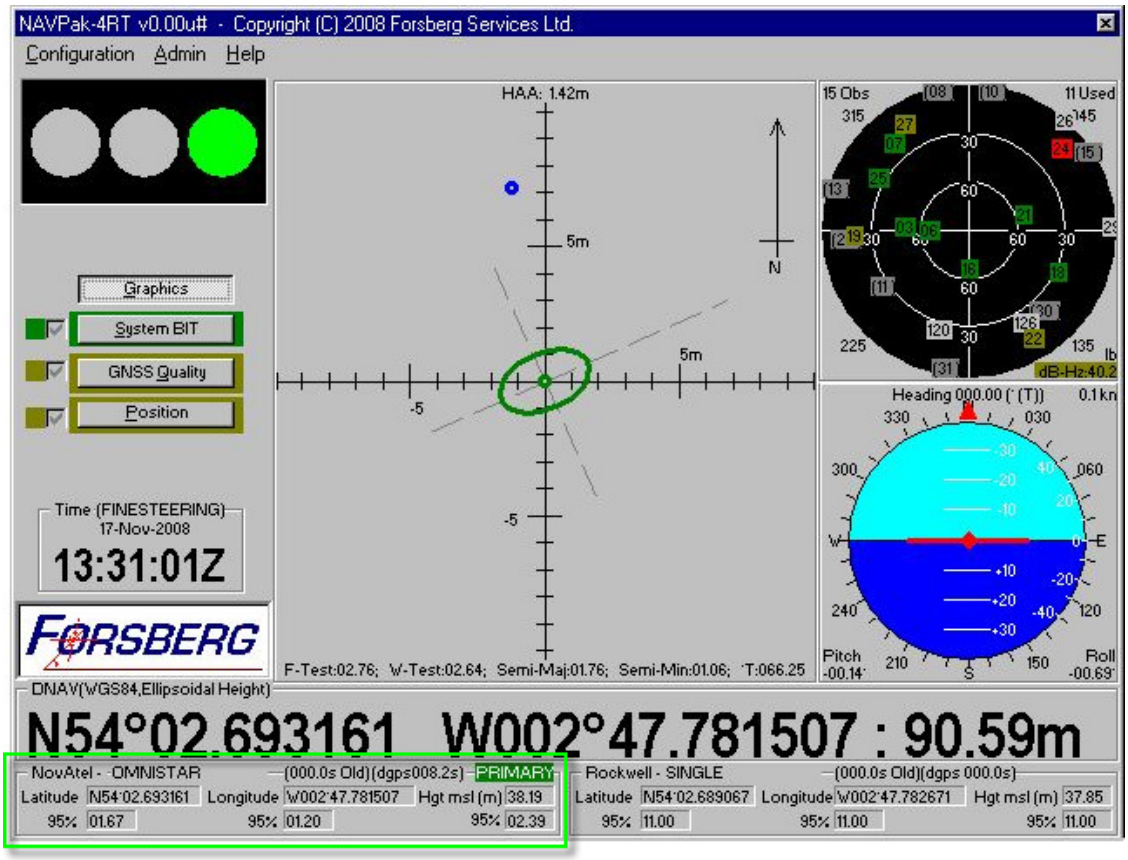

Figure 5 NAVPak-4 with NovAtel position

Position – This is given in WGS84 datum coordinates as a default state. Values shown are Latitude, Longitude and Height.

Height – This is given as a modelled height above the geoid (Mean Sea Level) except for the DNAV output where ellipsoidal height is shown. Ellipsoidal height is absolute and the difference between the two is known as “undulation” which is modelled within the receiver

Datum used (WGS84) – The datum used for all positions output by CPUPak-4 to display, data storage, NAUTIS and NAVPAK-4 is WGS84. The system under special non-standard conditions can be configured so that the NovAtel receiver uses alternative datums including a user-entered datum. Do not do this until you have fully researched the implications with ourselves (FSL.)

95% Probability – These values are quoted for the latitude, longitude and height coordinates of the computed positions and are given in metres. This value is stated as the half-axis dimension centred on the computed position within which there is a statistical 95% probability level of the position being re-observed.

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IMPORTANT NOTE: In the event of the antenna being disconnected from the CPUPak-4 system the NovAtel receiver will display the last known position and probability levels. The position solution and DNAV Failure will flag as a red alarm to indicate that the position is no longer reliant. You will also see the solution age increasing in seconds to indicate the time since the last known position.

3.5.3 Rockwell GPS receiver

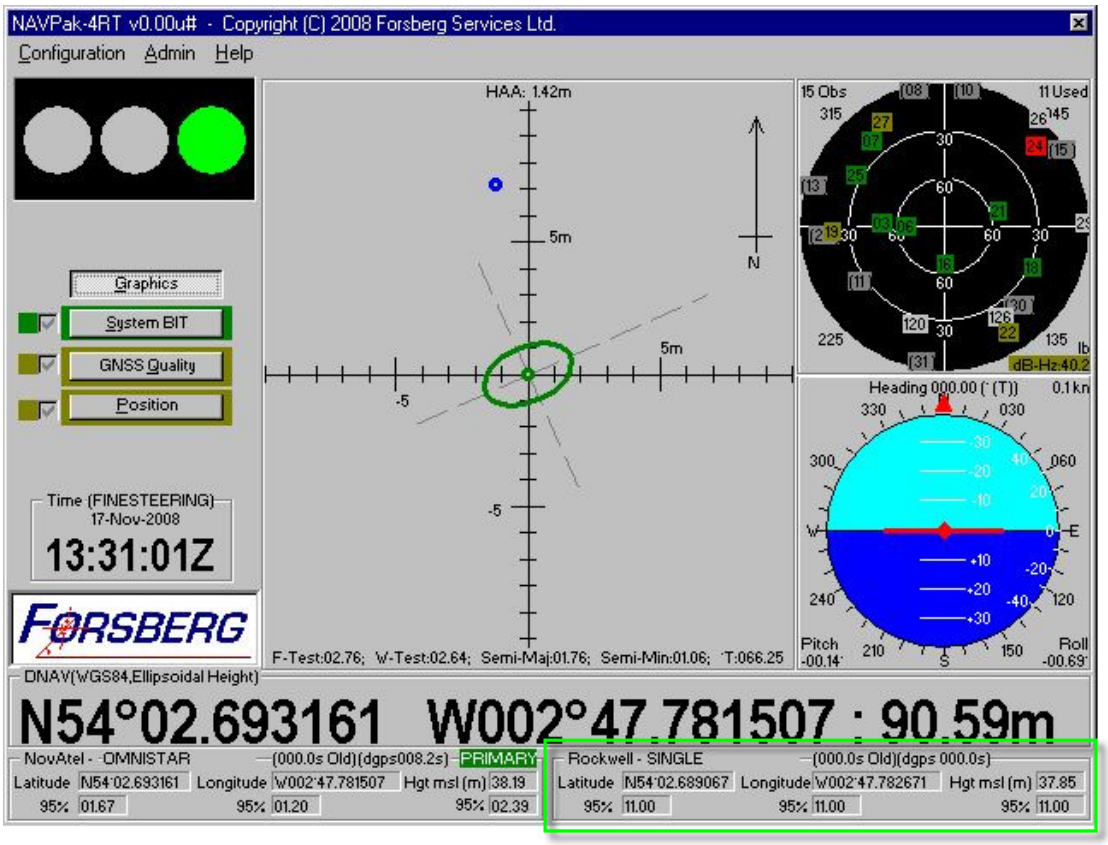

Figure 6 NAVPak-4 with Rockwell position output

Position – This is given in WGS84 datum coordinates as a default state. Values shown are Latitude, Longitude and Height.

Height – This is given as a modelled height above the geoid (Mean Sea Level) except for the DNAV output where ellipsoidal height is shown. Ellipsoidal height is absolute and the difference between the two is known as “undulation” which is modelled within the receiver

Datum used (WGS84) – The datum used for all positions output by CPUPak-4 to display, data storage, NAUTIS and NAVPAK-4 is WGS84. The Rockwell GPS receiver defaults to this setting. The user must refrain from selecting other datums and geodetic systems through keyboard interaction.

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95% Probability – These values are quoted for the latitude, longitude and height coordinates of the computed positions, and is given in metres. This value is stated as the half-axis dimension centred on the computed position within which there is a statistical 95% probability level of the position being re-observed. These values also represent the Estimated Horizontal Error (EHE) output from the Rockwell GPS. However, the Rockwell GPS approximates the values for one of the fields at least as the EHE values for latitude and longitude is always given as the same value. This EHE value should be taken as the Rockwell GPS best estimate of HAA (Horizontal Accuracy Assessment) according to advice from Rockwell.

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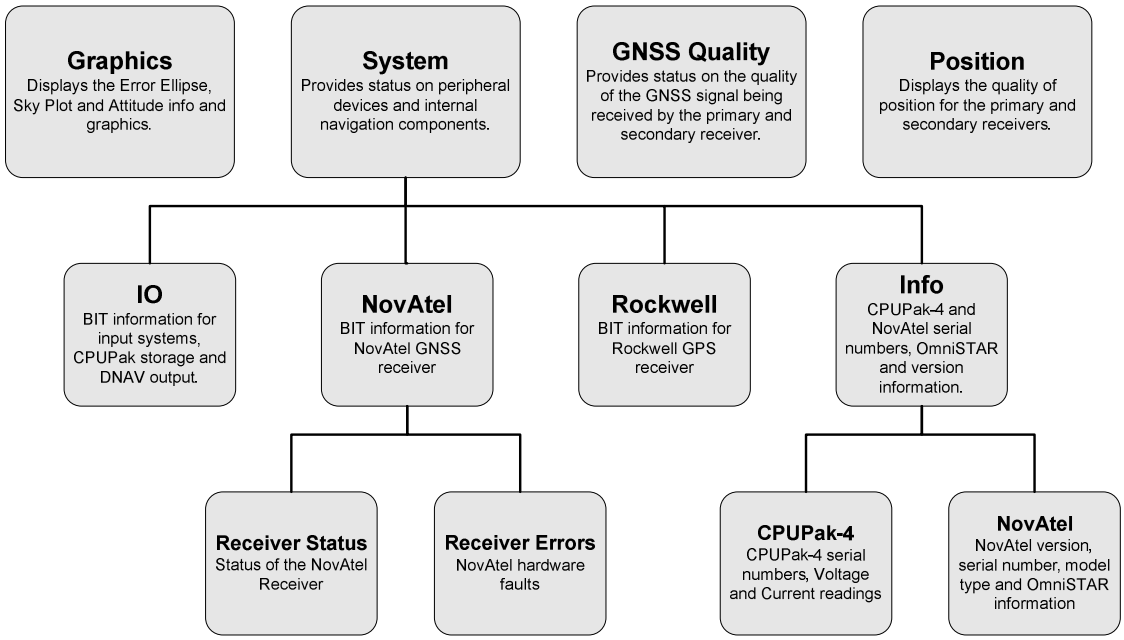
3.6 User interface map

The user interface has been restructured to allow operators to find a fault through the use of latched indicators. The BIT information has been split into several panels due to the size of information that is available. The following map shows how to access all of the BIT information in NAVPak.


Graphics
Displays the Error Ellipse, Sky Plot and Attitude info and graphics.
System
Provides status on peripheral devices and internal navigation components.
GNSS Quality
Provides status on the quality of the GNSS signal being received by the primary and secondary receiver.
Position
Displays the quality of position for the primary and secondary receivers.
IO
BIT information for input systems, CPUPak storage and DNAV output.
NovAtel
BIT information for NovAtel GNSS receiver
Rockwell
BIT information for Rockwell GPS receiver
Info
CPUPak-4 and NovAtel serial numbers, OmniSTAR and version information.
Receiver Status
Status of the NovAtel Receiver
Receiver Errors
NovAtel hardware faults
CPUPak-4
CPUPak-4 serial numbers, Voltage and Current readings
NovAtel
NovAtel version, serial number, model type and OmniSTAR information

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3.7 Graphical display

The graphical display is the main screen and will display on start-up.

3.7.1 Panels

The panel display is a new feature to this version of NAVPak-4 that allows a graphical representation of data to be shown on screen. The information displayed in the main panel can be swapped with one of the sub panels by clicking on the sub panel.

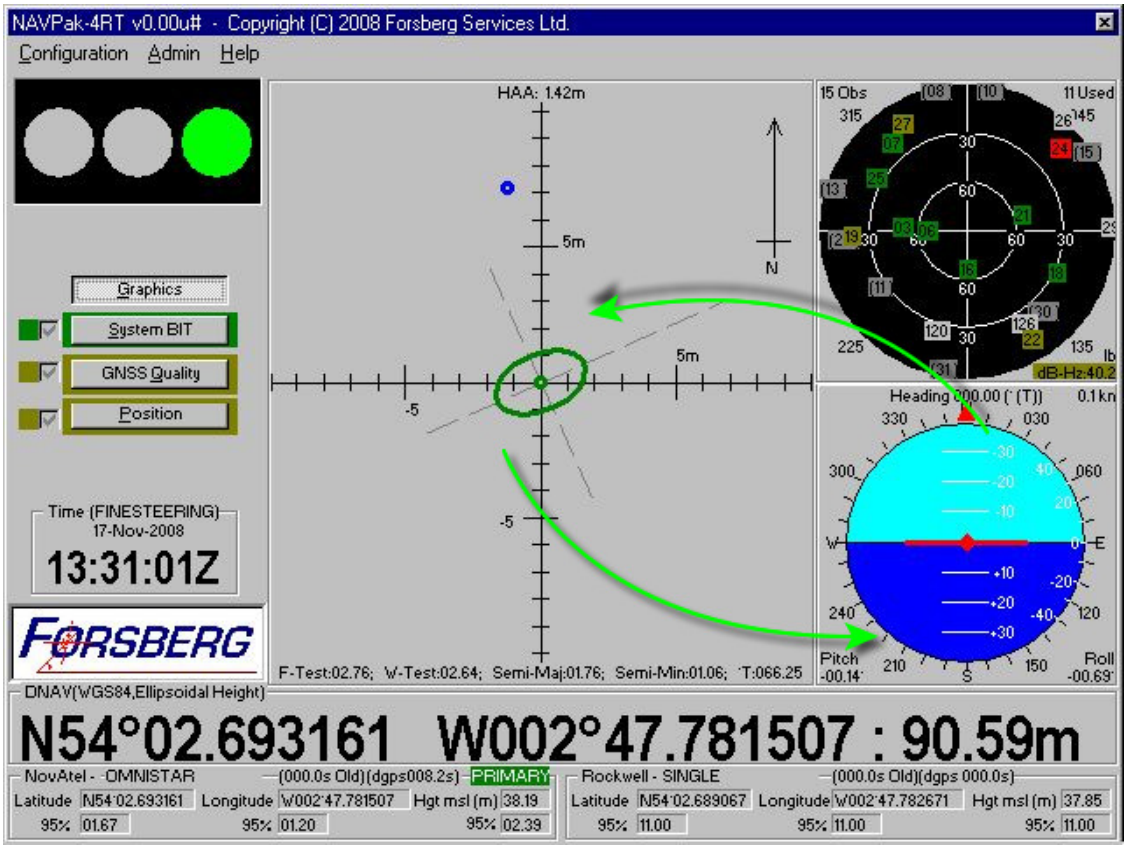

Figure 7 Panel switching

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3.7.2 Error Ellipse

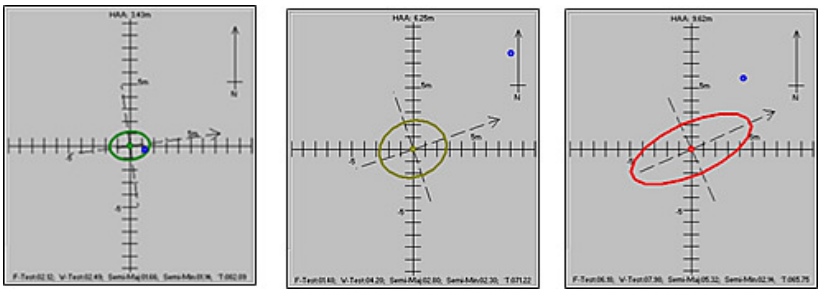

Figure 8 Error Ellipse graphic

The error ellipse panel shows the error ellipse around the selected primary receiver position (green dot) positioned on an axis. The ellipse is drawn from the semi-major and semi-minor data. To provide a quality indication the ellipse will alter its colour as an indication of the current HAA (Horizontal Accuracy Assessment) against the threshold. The blue dot represents the secondary receiver position.

Data	Description
HAA	Horizontal Accuracy Assessment
F-Test	F- Test The value is the square value of the maximum/minimum ellipse axes. A value of twenty-five may have its acceptability questioned.
W-Test	W-Test The value is the estimated 3 sigma (98.9%) radius of probability within which the true reported position is likely to lie.
Semi-Maj	Semi-major axis of the error ellipse
Semi-Min	Semi-minor axis of the error ellipse
^{o}T	Orientation of semi-major axis in degrees true

This display gives the 95% probability level for the Primary Navigation HAA (Horizontal Accuracy Assessment) while it also shows the 99% accuracy probability level by the W Test. Both measures are in metres as are those for the semi-major axis (a) and semi-minor axis (b) of the error ellipse which show the 2 sigma (two standard deviation or 95%) probability level.^{o}T is the orientation of the semi-major axis (a) in degrees.

The F Test value is a proportional ratio of the squared value of semi-major axis (a) divided by the squared value of semi-minor axis (b) and as such would give a value of 36 if the eccentricity of the error ellipse was such that: a = 5 x b. This value of 25 might be viewed as being a suitable maximum for questioning whether a positioning system was up to standard for accurate positioning work. Reference to the U.K.H.O (United Kingdom Hydrographic Office) would help to set a useable level. For a more formal F Test, link this value to the number of observations for each epoch.

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3.7.3 Sky Plot

The sky plot provides a graphical display of the satellite geometry as being received by the primary receiver.

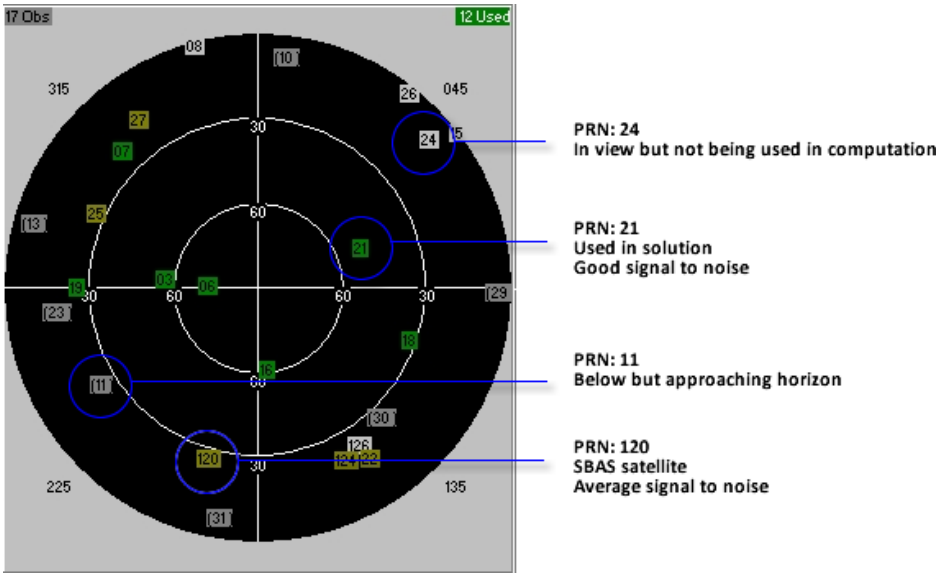

Figure 9 Sky Plot

The satellite systems are represented by the following PRN (pseudo random noise) numbers.

1-32	GPS
38-61	GLONASS
100-138	SBAS

The PRN number is surrounded by a colour to represent the carrier to noise ratio. The table below shows the key for the sky plot.

Box colour	Key	Description	Suggested C/No
RED	32	Bad signal to noise ratio	Less than 35 dB-Hz
AMBER	04	Average signal to noise ratio	Between 35 – 45 dB-Hz
GREEN	14	Good signal to noise ratio	Between 45 – 51 dB-Hz
WHITE	120	Satellite is visible but not used in solution	N/A
DARK GREY (PRN in brackets)	(17)	Satellite is below but inside 30 degrees of the horizon.	N/A

The position of the satellite is shown against the bearing with respect to True North, where True North is 0 degrees on the indicator around the plot. The elevation above the horizon is marked on the centre crosshair.

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When a PRN number is wrapped by brackets it represents a satellite that is below the horizon but is close to the sky view. Once in sky view the brackets will no longer display and the satellite will be coloured accordingly. This information has been provided on screen to give an indication of the satellites possibly approaching the sky view.

When SBAS differential corrections are being used, the SBAS satellite in use will display an asterisk besides its PRN number. The C/No of the SBAS satellite will also be displayed in the lower right corner of the panel.

When L-Band corrections are being used, the C/No of the L-Band satellite is displayed in the lower right hand corner of the panel.

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3.7.4 Attitude Plot

The attitude plot displays the data output from the inclinometer unit.

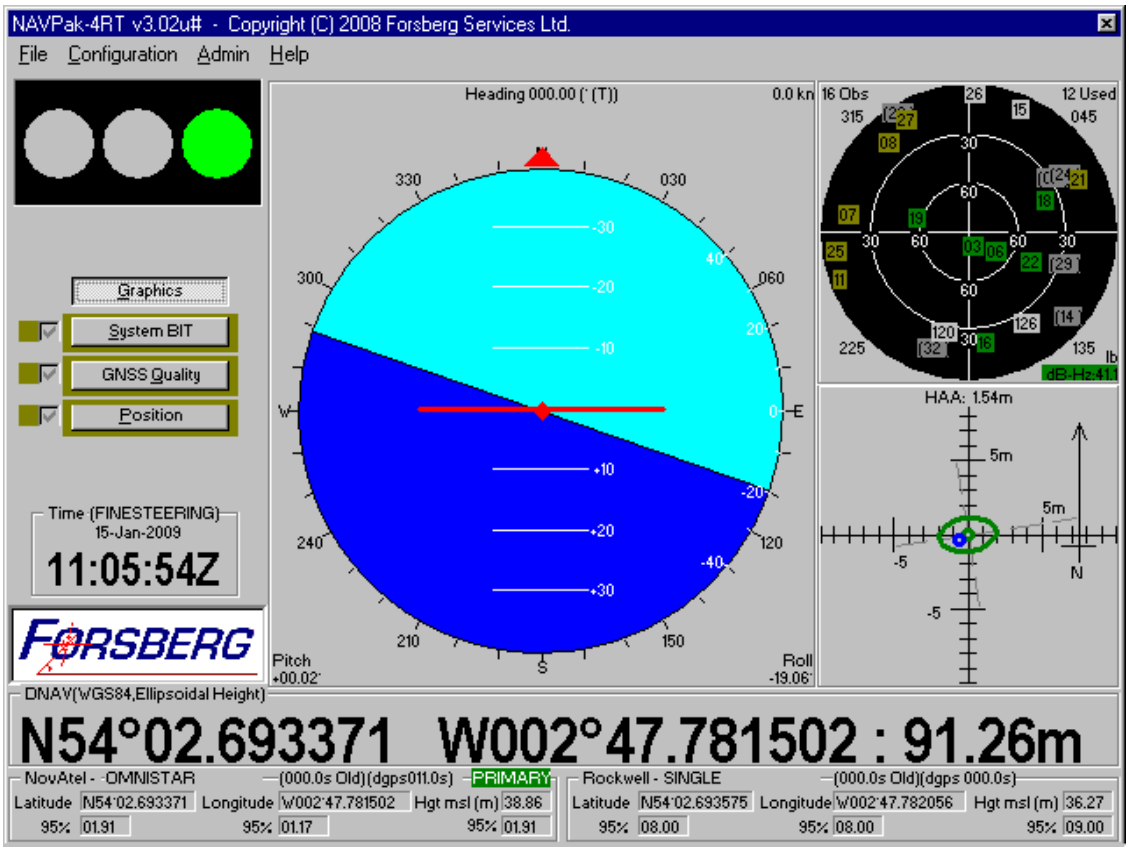

Figure 10 Attitude Plot

Roll: The Roll in degrees is represented using the level contained inside the compass image. The roll value is illustrated as a semi-circle marker on the right hand side of the inner display. The exact roll value is displayed as text within the panel.

Pitch: The Pitch in degrees is represented using the red diamond and red line inside the compass. The pitch of the vessel is value lined up beside the red diamond and the red line represents the level line. The exact pitch value is displayed as text within the panel.

Heading: The Heading in degrees true is represented as the red arrow on the compass ring that surrounds the display. The exact heading value is displayed as text within the panel.

Speed: The speed is represented as text inside the panel and is displayed as Knots.

This display gives actual pitch, roll and gyro heading of the vessel. Comparison of the gyro heading and “Track Made Good, True” will give the yaw angle (or set due to tide and wind).

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Pitch and roll are read from pitch roll sensors. Positive pitch in a ship for example is bows down – stern up. Positive Roll is starboard (right) side down – port (left) side up. The CAL figures are the alignment figures for the pitch/roll sensor when the ship is trimmed up level. The values should never change once set for a particular ship unless the system is moved.

Heading comes from a heading sensor and in a ship this might be the ship's gyrocompass possibly through a synchro to serial converter and on to the CPUPak-4. The heading is in degrees with valid value being between 0 and 359.9 read in a clockwise direction as per standard compass practice.

3.8 System display

The system display shows the BIT information relating to the CPUPak-4 system and its peripheral devices. The system BIT should be used with other alarms to diagnose a fault.

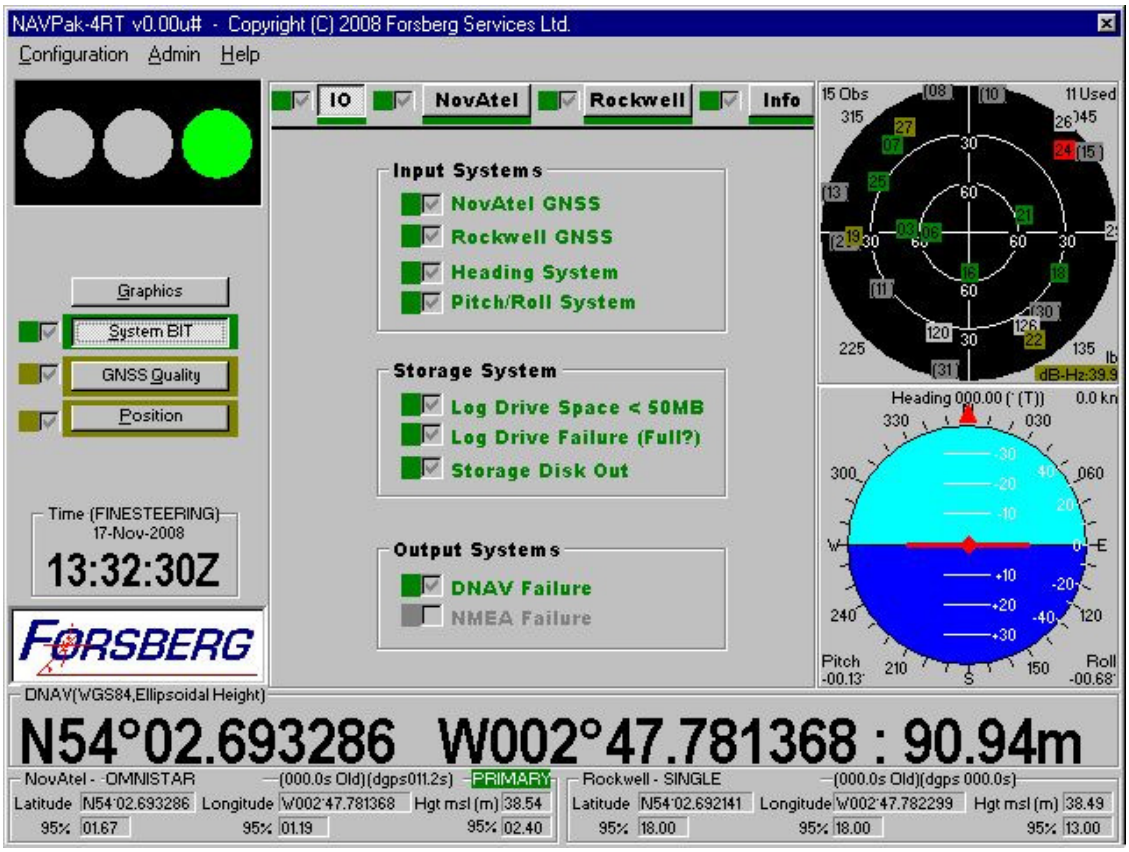

Figure 11 System BIT panel

See NAVPak-4 BIT alarms for detailed information on the alarms on this screen

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3.8.1 GNSS - NovAtel

This display shows the BIT information for the NovAtel receiver. The information is broken down into two groups, Receiver Status and Receiver Errors, both of which can be accessed from the tabs at the top of the display.

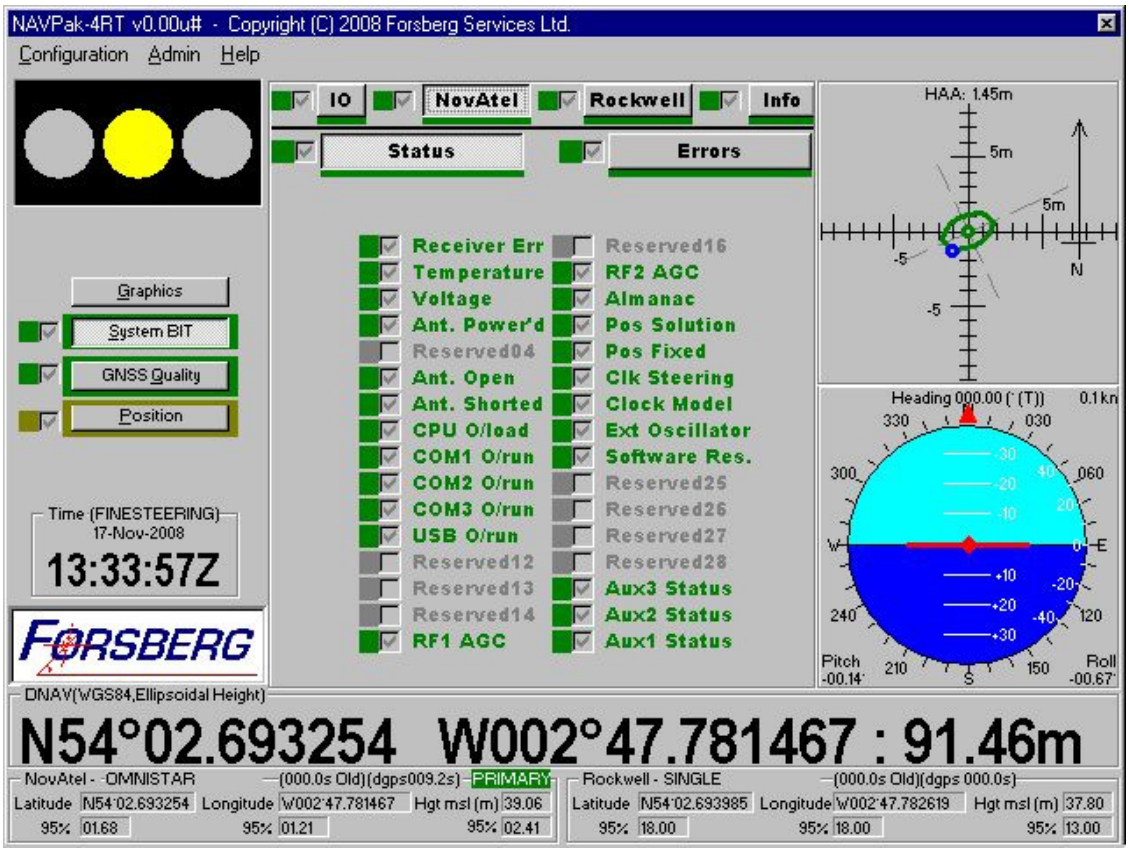

Figure 12 GNSS - NovAtel BIT screen

Note: All “Reserved” fields have been added to the system to allow for future upgrades to the system.

See NAVPak-4 BIT alarms for detailed information on the alarms on this screen

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3.8.2 GNSS – Rockwell

This display shows the BIT information for the Rockwell receiver.

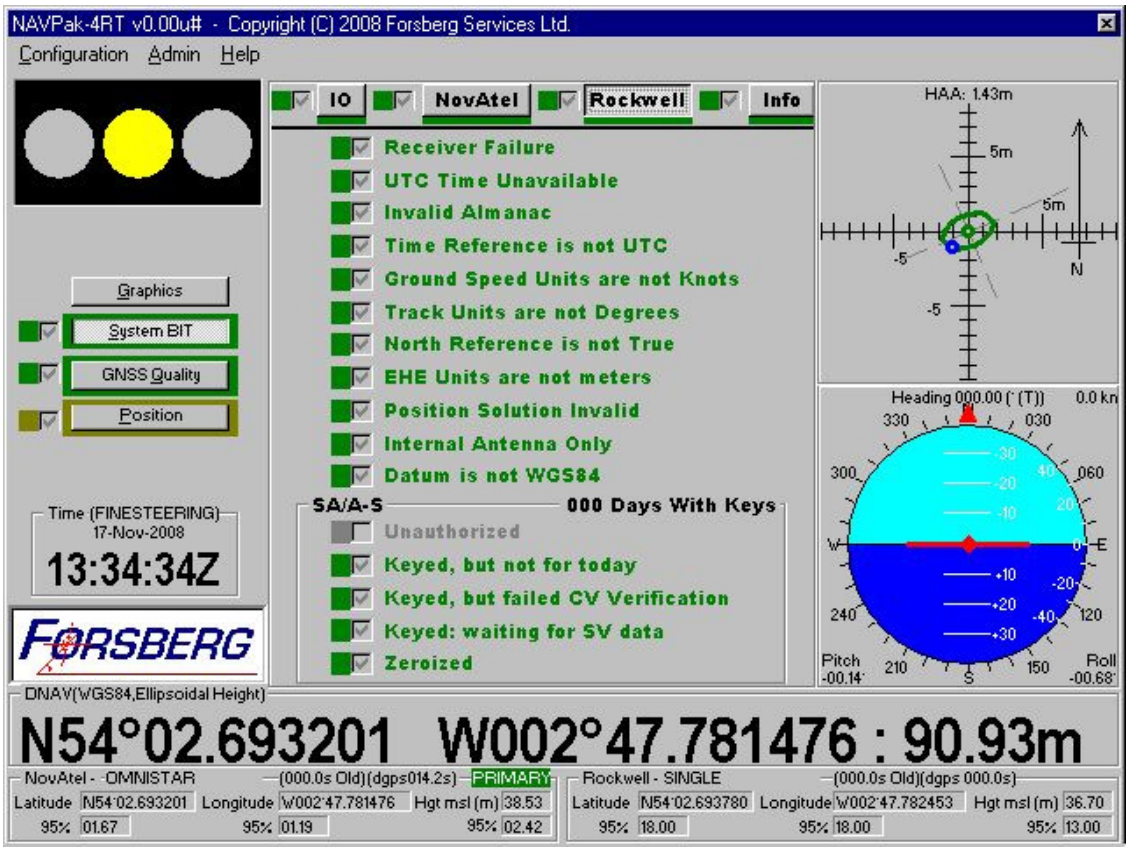

Figure 13 GNSS - Rockwell BIT screen

See NAVPak-4 BIT alarms for detailed information on the alarms on this screen

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3.8.3 Info

This displays the information relating to the CPUPak-4, and NovAtel and Rockwell receivers.

3.8.3.1 CPUPak-4 Info

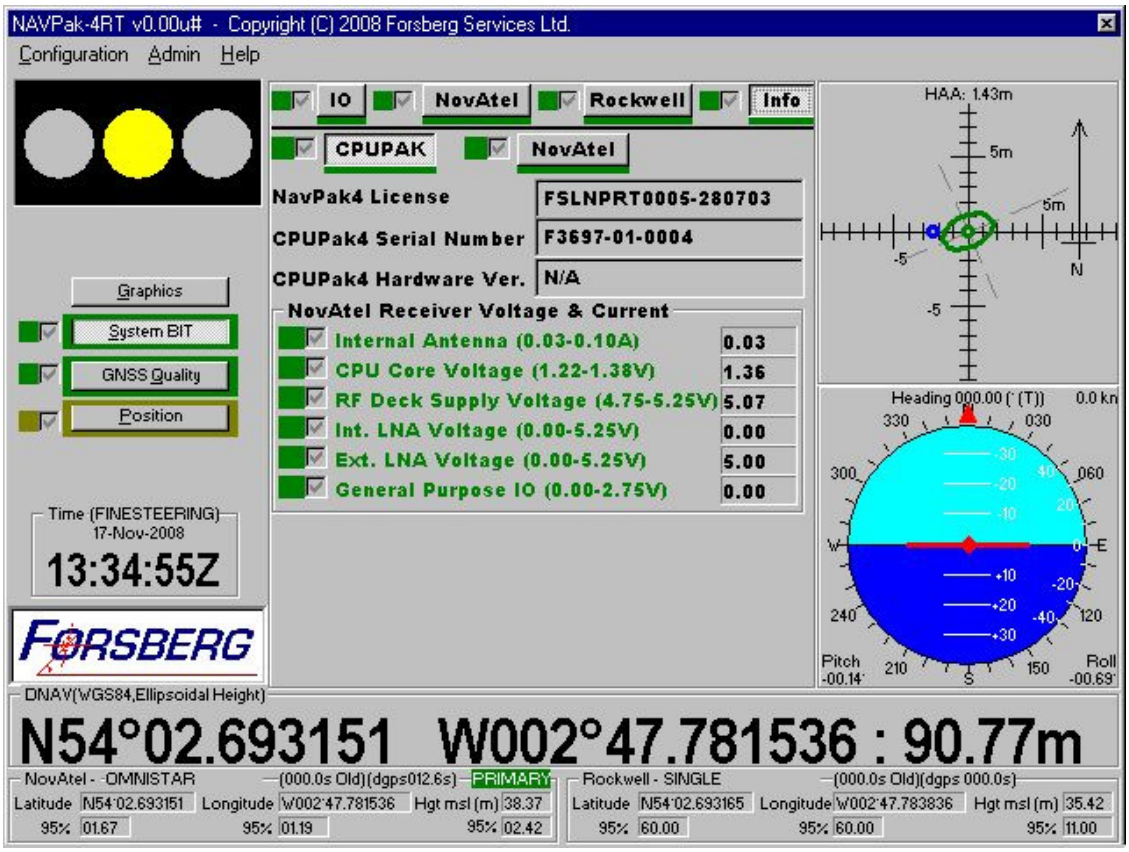

Figure 14 CPUPak-4 info panel

NAVPak-4 License: The license number of the NAVPak-4 software

CPUPak-4 Serial: The associated CPUPak-4 unit serial number

CPUPak-4 Hardware Version: The hardware version of the associated CPUPak-4 unit.

CPUPAk-4 BIT: *See NAVPak-4 BIT alarms for detailed information on the alarms*

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3.8.3.2 NovAtel Info

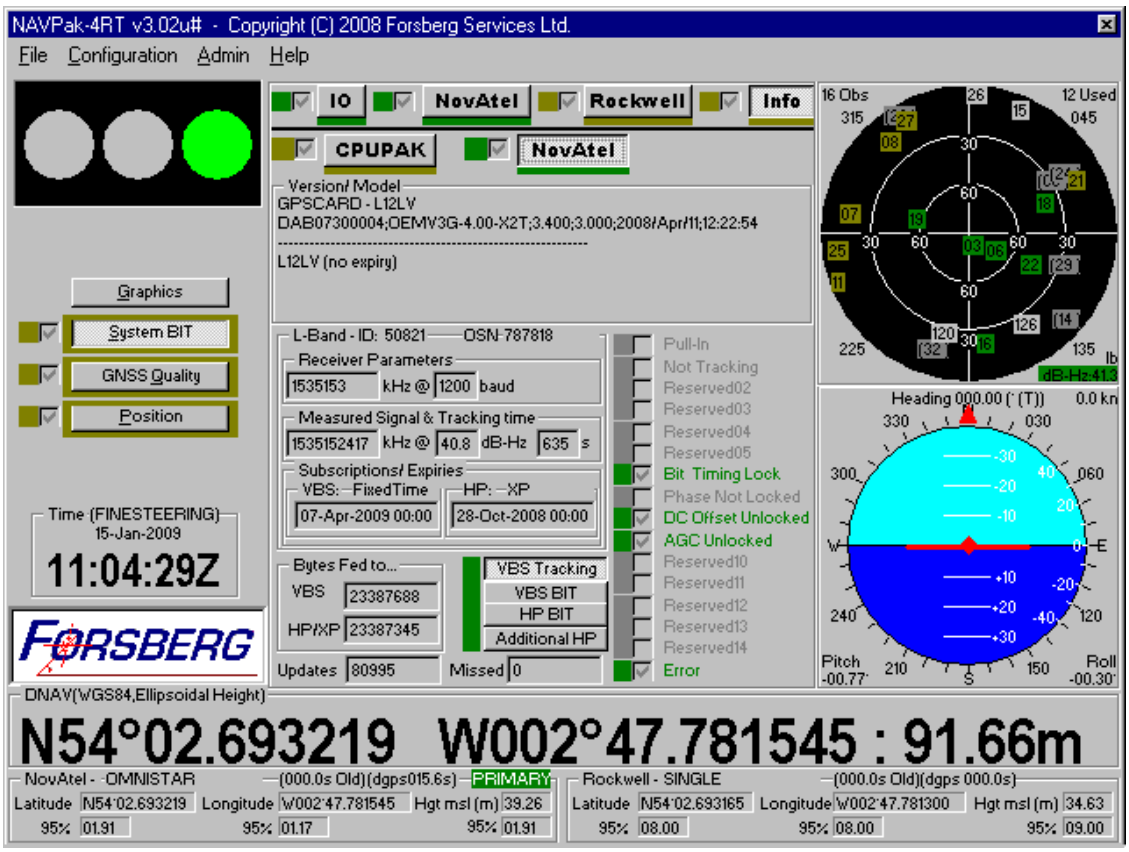

Figure 15 NovAtel info panel

Version/ Model: This displays the version and model of the NovAtel receiver and matches the output of the VERSION message. Please see the NovAtel Firmware Manual for more information.

L-Band: The information necessary when ordering an OmniSTAR or SeaSTAR correction signal.

Receiver Parameters: Frequency and baud rate that the receiver is configured to. This is controlled through the Differential Corrections panel.

Measured Signal and Tracking Time: The received L-Band signal measurements and tracking times.

Subscription/ Expires: The expiry date of the OmniSTAR signals

Signal/ HP and VBS BIT: *See NAVPak-4 BIT alarms for detailed information on the alarms*

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3.9 GNSS Quality

This display shows the BIT relating to the quality of the GNSS signal being received by the NovAtel and Rockwell receiver.

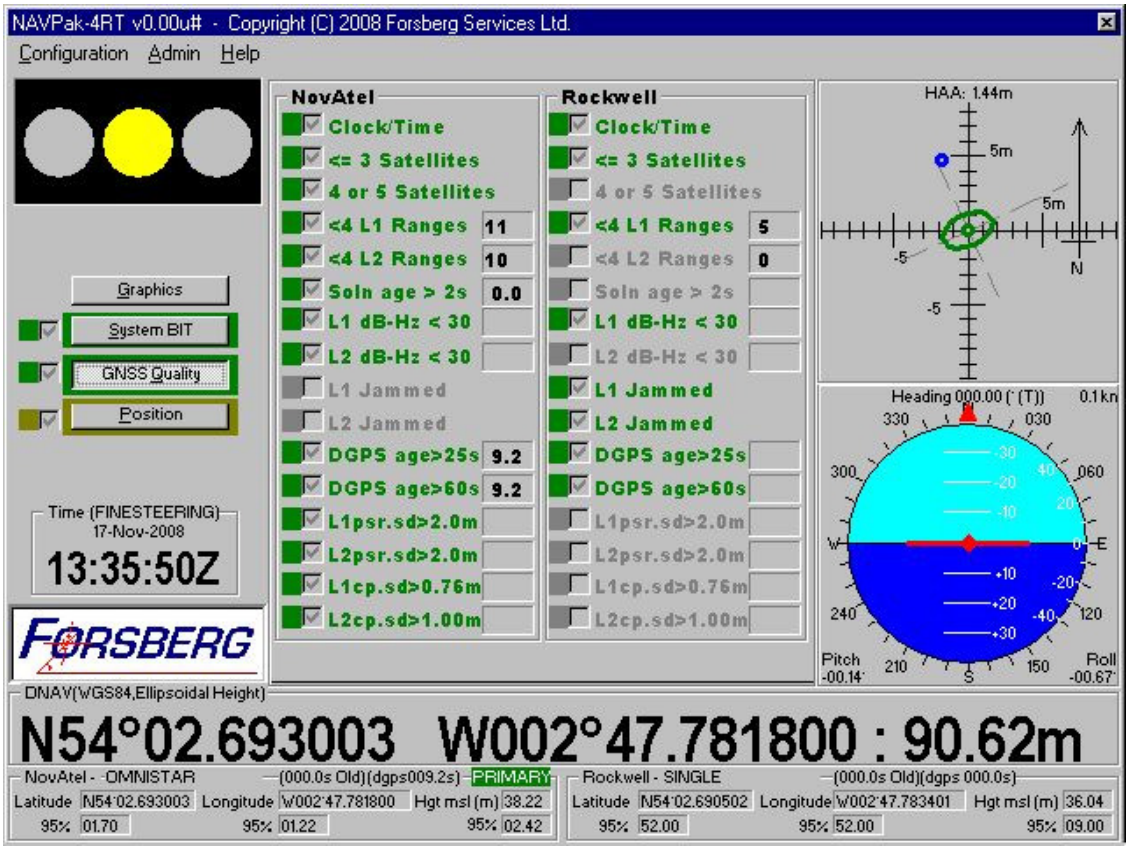

Figure 16 GNSS Quality BIT

See NAVPak-4 BIT alarms for detailed information on the alarms on this screen

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3.10 Position

This display shows the quality of position BIT from the NovAtel and Rockwell receivers.

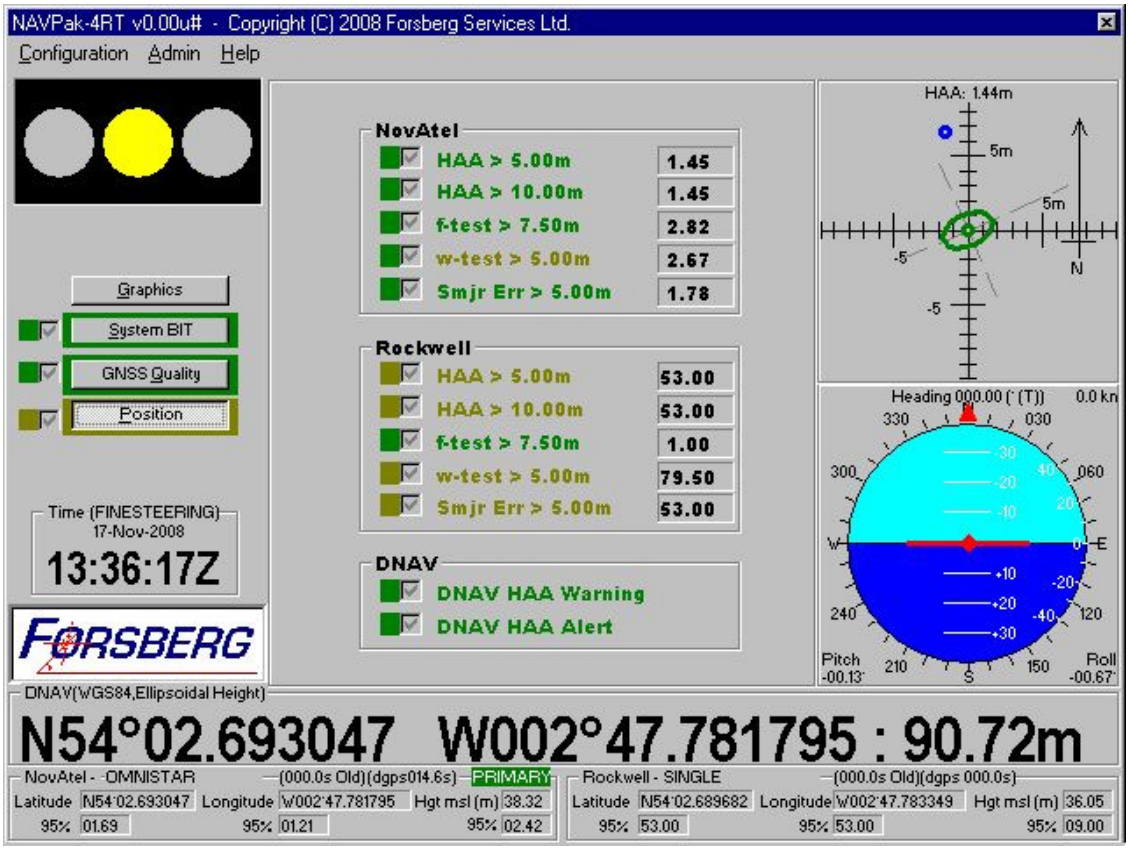

Figure 17 Position BIT

See NAVPak-4 BIT alarms for detailed information on the alarms on this screen

3.11 Logged Data

NAVPak-4 software automatically starts logging data on start up. This data can be used for fault finding and post processing and it is advised that all data files are saved to the storage device and backed up continuously.

Logged data is saved in the following format:

1. On start up the software will create a folder in D:/ NAVPak/. The folder will reflect the date that the software was started in the format YYYY-MM-DD.
2. Within this folder a new folder will be created for each time the software is started.
3. Within this folder the data files shall be stored where the suffix will indicate the type of data file
4. When the software runs into a new day a new folder is created and the files will started.

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An example of the data is shown below.

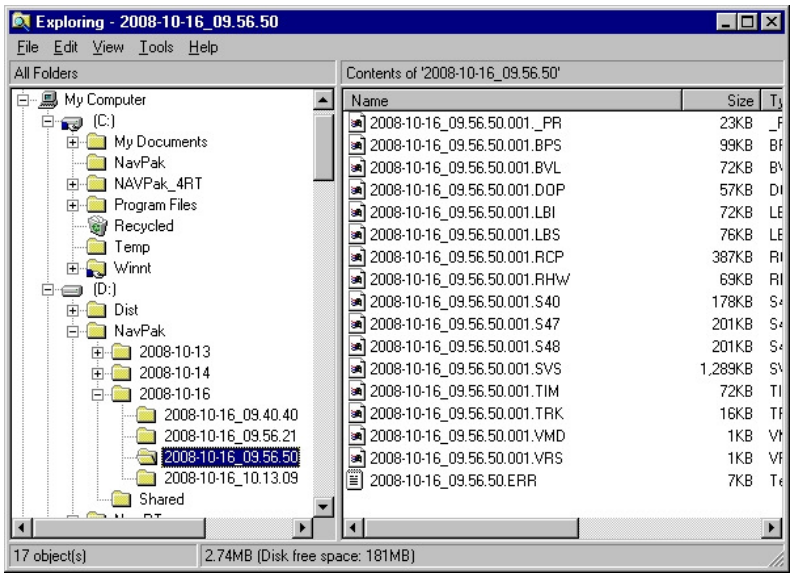

Figure 18 Windows explorer showing logged files

Logged data files:

#	File name	Description
1	".Trk"	Heading
2	"._PR"	Pitch/roll
3	".BPS"	BESTPOS (NovAtel)
4	".RCP"	RANGECMP (NovAtel)
5	".EEL"	GPGST (NovAtel)
6	".GRS"	GPGRS (NovAtel)
7	".VRS"	VERSION (NovAtel)
8	".RHW"	RXHWLEVELS (NovAtel)
9	".TIM"	TIME (NovAtel)
10	".BVL"	BESTVEL (NovAtel)
11	".DOP"	PSRDOP (NovAtel)
12	".VMD"	VALIDMODELS (NovAtel)
13	".SVS"	SATVIS (NovAtel)
14	".LBI"	LBANDINFO (NovAtel)
15	".LBS"	LBANDSTAT (NovAtel)
16	".S04"	SPGR Msg5004 (Rockwell)
17	".S40"	SPGR Msg5040 (Rockwell)
18	".S47"	SPGR Msg 5047 (Rockwell)
19	".S48"	SPGR Msg 5048 (Rockwell)

Error and Event files:

#	File name	Description
1	EVT.TXT	Logs usage of admin and config menus
2	ERR.TXT	Logs warnings and start and end fault conditions.

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4 Configuration and Admin Menu

4.1 Overview

The configuration and administration menu provides the functionality to the settings of the NAVPak-4 software for extra control and additional features such as setting differential corrections and issuing the receiver with a specific command.

4.2 Configuration menu

4.2.1 QC Data intervals

This menu panel allows the operator to change the data-logging interval. The interval may be any value in whole seconds from 10 seconds to 3600 seconds in ten second steps e.g. 10, 20, 30…3600. This setting will only affect selected data such as BIT for the OEMV and SeaSTAR VBS service. All other data used for any part of the DNAV message is logged at one second intervals. Logging all possible data at the maximum rate, once every ten seconds, will cause data to be logged at a volume 0.610Mb/hour greater than if all possible data logs were logged at the slowest rate of once every 3600 seconds (one hour).

4.2.2 Primary GPS

Set either the NovAtel or Rockwell receiver as the primary receiver. Selection will affect the information displayed on screen and the output in the DNAV message, The DNAV message contains the position of the primary receiver.

4.2.3 Differential Corrections

Set to enable or disable differential corrections. The default is “enable” to allow for differential corrections to be received. Corrections may need to be configured to ensure that the receiver is set up correctly. This is controlled under the admin menu.

4.3 Admin menu

4.3.1 Change password

The password can be changed by the expert user using this feature.

4.3.2 Alert thresholds

The menu is accessed from the Admin drop down menu. After entering a System Administrator password the user will be able to change the levels at which alert thresholds are triggered. To close the panel without change use the keyboard ESC key.

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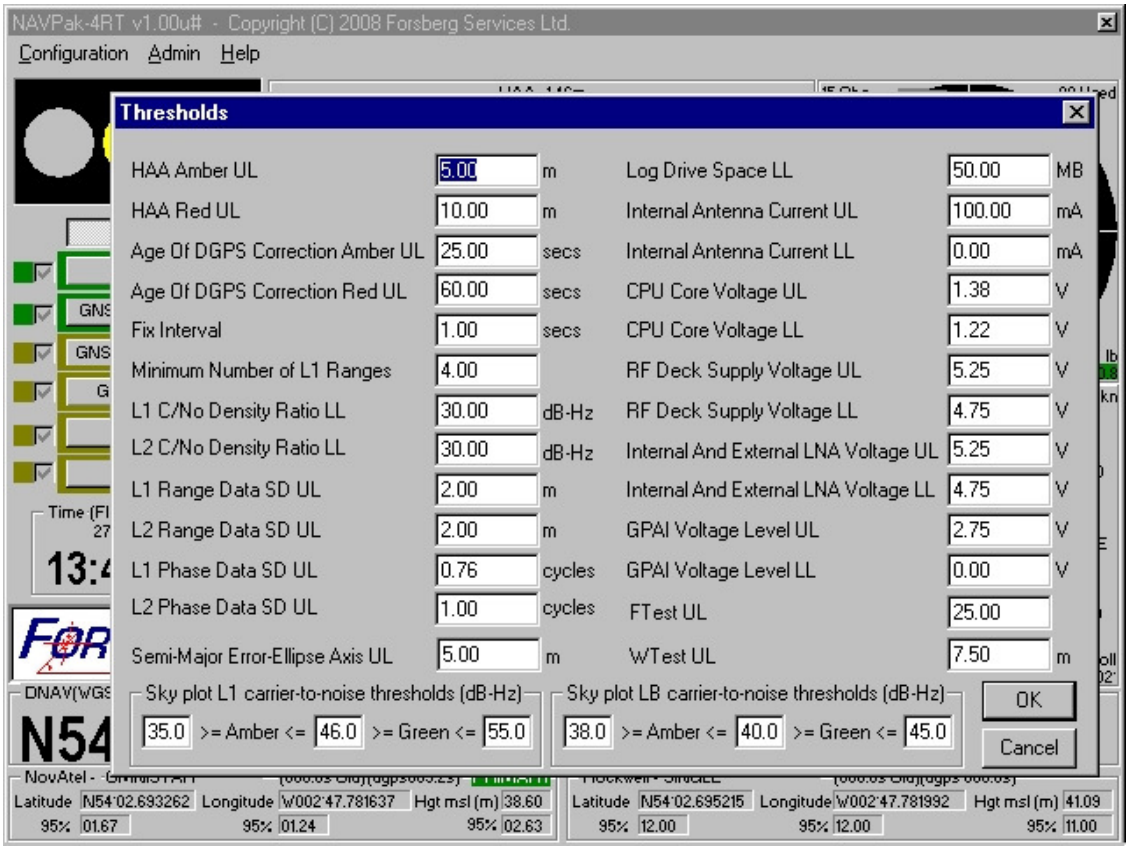
NAVPak-4RT v1.00u# - Copyright (C) 2008 Forsberg Services Ltd.
Configuration Admin Help
Thresholds
HAA Amber UL 5.00 m
HAA Red UL 10.00 m
Age Of DGPS Correction Amber UL 25.00 secs
Age Of DGPS Correction Red UL 60.00 secs
Fix Interval 1.00 secs
Minimum Number of L1 Ranges 4.00
L1 C/No Density Ratio LL 30.00 dB-Hz
L2 C/No Density Ratio LL 30.00 dB-Hz
L1 Range Data SD UL 2.00 m
L2 Range Data SD UL 2.00 m
L1 Phase Data SD UL 0.76 cycles
L2 Phase Data SD UL 1.00 cycles
Semi-Major Error-Ellipse Axis UL 5.00 m
Log Drive Space LL 50.00 MB
Internal Antenna Current UL 100.00 mA
Internal Antenna Current LL 0.00 mA
CPU Core Voltage UL 1.38 V
CPU Core Voltage LL 1.22 V
RF Deck Supply Voltage UL 5.25 V
RF Deck Supply Voltage LL 4.75 V
Internal And External LNA Voltage UL 5.25 V
Internal And External LNA Voltage LL 4.75 V
GPAI Voltage Level UL 2.75 V
GPAI Voltage Level LL 0.00 V
FTest UL 25.00
WTest UL 7.50 m
Sky plot L1 carrier-to-noise thresholds (dB-Hz)
35.0 >= Amber <= 46.0 >= Green <= 55.0
Sky plot LB carrier-to-noise thresholds (dB-Hz)
38.0 >= Amber <= 40.0 >= Green <= 45.0
OK
Cancel
Latitude N54°02.693262 Longitude W002°47.781637 Hgt msl (m) 38.60
Latitude N54°02.695215 Longitude W002°47.781992 Hgt msl (m) 41.09

Figure 19 Alert Thresholds

Thresholds that may be adjusted are:

Threshold	Suggested Value
HAA Amber UL	**5.00**
HAA Red UL	**10.00**
Age of DGPS correction Amber UL	**25.00**
Age of DGPS correction Red UL	**60.00**
Fix Interval	**1.00**
Minimum Number of L1 Ranges	**4.00**
L1 C/No Density Ratio LL	**30.00**
L2 C/No Density Ratio LL	**30.00**
L1 Range Data SD UL	**2.00**
L2 Range Data SD UL	**2.00**
L1 Phase Data SD UL	**0.76**
L2 Phase Data SD UL	**1.00**
Semi-major error-ellipse axis UL	**5.00**
Log drive space LL	**50.00**
Internal Antenna Current UL	**100.00**
Internal Antenna Current LL	**0.00**
CPU Core Voltage UL	**1.38**
CPU Core Voltage LL	**1.22**
RF Deck Supply Voltage UL	**5.25**
RF Deck Supply Voltage LL	**4.75**

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Internal and External LNA Voltage UL	**5.25**
Internal and External LNA Voltage LL	**4.75**
GPA Voltage Level UL	**2.75**
GPA Voltage Level LL	**0.00**
FTest UL	**25.00**
WTest UL	**7.50**
Sky plot L1	**35, 46, 55**
Sky plot LB	**38, 40, 45**

These default values should work in all instances to meet the system overall requirements. However frequent activation of any alarm, such as the HAA lower threshold alarm, may encourage the "System Administrator" to take a view that the threshold should be raised or lowered to minimise repeated alarm conditions.

C/No Density Ratio can be exceeded when satellites are moving in and out of view, or are close to the horizon. The same applies to the Range and Phase Data SD values.

The CPU Core Voltage varies between OEMV cards as several different processor models and settings have been used by NovAtel. Centre voltages have in the past been either 1.5V or 1.3V. Later models have a 1.1V option.

It is recommended that electrical thresholds are set after consulting the NovAtel OEMV User's Manual. The CPUPak-4 should be delivered with the correct value set.

4.3.3 Unlock warning checkboxes

Once selected the BIT screen shall activate the check boxes to allow the expert user to de-select and select the error conditions that they require. A disabled warning will have no effect on the latched or transitory states. It may be desirable to disable inapplicable warnings.

4.3.4 Differential corrections

The user can select which differential corrections to receive via the NAVPak-4RT software. The software provides the user with an option for each type of corrections or to have no corrections at all.

1. Click "Admin" at the top of the screen to open the drop-down menu
2. Select "Configure Differential Corrections" from the menu
3. Enter password and select "OK"
4. The differential corrections configuration box will pop-up on the screen

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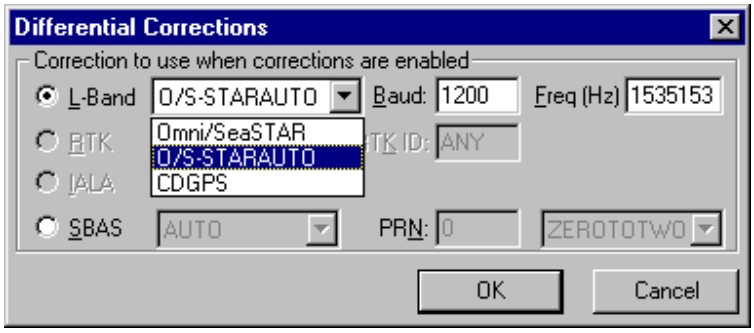

Figure 20 Differential Corrections Panelwith L-Band drop down

5. To nominate a correction, select the appropriate icon beside the desired correction. This activates the settings for the chosen configuration.
6. Where applicable, select the required settings from the drop-down boxes or input fields.
7. Once the correction has been selected and configured select “OK”

The following corrections are available through NAVPak. Please consult with the NovAtel family firmware manual for more information.

L-Band
This command will ensure that the receiver searches for a specified L-Band satellite at the specified frequency and baud rate. When AUTO is selected under OmniSTAR the receiver will automatically look for the best satellite. When setting the receiver to use SBAS corrections ensure that the Omni/ Sea STAR option has been selected to obtain an OMNISTAR position. Once the OMNISTAR position has been received

L-Band	**Omni/Sea STAR (default)** Use the OmniSTAR correction system **O/S STARAUTO** When selected the receiver will automatically select the best OmniSTAR beam to track base on the receiver’s position. *This mode should be selected after Omni/sea STAR has been initialised.* **CDGPS** Use the Canadian DGPS system	**Baud:** 300, 600, 1200, 2400 or 4800	**Freq (Hz):** 1525000 to 1560000 Or 1525000000 to 1560000000 **Default:** 1535153

SBAS
A Satellite Based Augmentation System (SBAS) is a system that supports wide-area or regional augmentation (e.g. EGNOS and WAAS) through the use of additional satellite-broadcast messages. NAVPak-4 can accept SBAS corrections which are set up through the differential corrections panel. SBAS is set to proliferate worldwide with the addition of systems such as GRAS, MSAS, SNAS, GAGAN and others in Australia, Japan, China and Australia respectively.

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When SBAS has been selected and the position is being corrected through SBAS corrections the position will show a “WAAS” solution. At the moment the receiver will only displays “WAAS” text even though the corrections may be received from a different system. This is a receiver function that may be upgraded in the future but be aware that a WAAS solution shows that the receiver is correctly receiving SBAS corrections.

SBAS	**AUTO:** Receiver will automatically pick the best system **ANY:** Receiver will pick any system **WAAS:** Receiver will only use corrections from the WAAS system **EGNOS:** Receiver will only use corrections from the EGNOS system **MSAS:** Receiver will only use corrections from the MSAS system	**PRN number:** **0:** Receiver uses any PRN (default) **SBAS: 120-138** Receiver will use SBAS corrections only from the entered PRN. If this is required the sky plot should be used to identify which SBAS satellite is in view.	**NONE:** Receiver interprets Type 0 messages as they are used (as do not use). **ZEROTOTWO (default):** Receiver interprets Type 0 messages as Type 2 messages **IGNOREZERO:** Receiver ignores the usual interpretation of Type 0 messages (as do not use) and continue

Important Note:
If using SBAS corrections for extended periods of time ensure that an expert users disables the OmniSTAR BIT information under the NovAtel Info panel. These alarms are specific to the OmniSTAR signal and can be disabled by the operator.

4.3.5 Enable the CRPA antenna

This will apply power to a connected CRPA antenna.

4.3.6 NovAtel GPS using CRPA antenna

Select enable or disable from the menu if the NovAtel receiver is using the CRPA antenna. This information is important for lever-arm corrections. The software must know which antenna to use so that it applies the correct lever arm corrections.

4.3.7 Rockwell GPS using CRPA antenna

Select enable or disable from the menu if the NovAtel receiver is using the CRPA antenna. This information is important for lever-arm corrections. The software must know which antenna to use so that it applies the correct lever arm corrections.

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4.3.8 NovAtel command

The NovAtel command provides a field to enter commands directly to the NovAtel GPS receiver. Use the NovAtel firmware reference manual for references to commands and be aware that NAVPak-4 uses commands from NovAtel when processing the display data. Modifying this data may affect the output. This feature should only be used by an expert user.

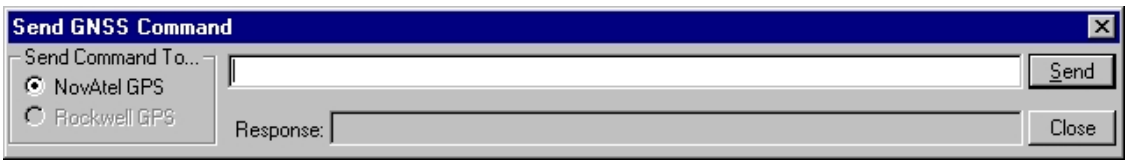

Figure 21 NovAtel command field

Commands should be entered into the top text field and sent to the receiver by pressing the “Send” button. The acknowledgement from the NovAtel receiver will be seen in the response field.

4.3.9 Reset NovAtel GPS

This reset function will reset the NovAtel receiver to its start-up setting.

4.3.10 Reset Rockwell GPS

This reset function will reset the NovAtel receiver to its start-up setting.

4.3.11 Remove log drive

The compact flash drive should be removed using this feature. The Remove log drive selection will allow the compact flash drive to be removed safely using the installed Card Wizard software.

4.3.12 Disable logging of

The “Disable logging of” option provides the full list of logged messages which can be turned on or off using the check-boxes. As a default all of the messages are logged. The NovAtel and Rockwell firmware manuals should be used to identify the meaning and importance of each log.

The screenshot below shows the Disable Logging of panel and the full selection of data.

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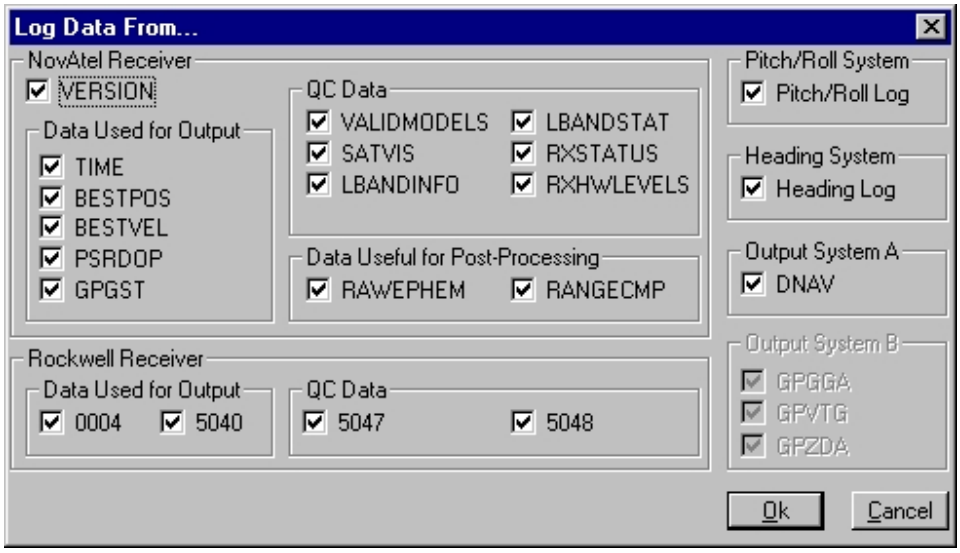

Figure 22 “Log Data From” Panel

4.3.13 Shutdown for backup

When this feature is selected the NAVPak-4 software shall save the logged data to a shared drive to allow the logged data to be backed up and then the system will shut down.

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5 NAVPak-4 BIT information

5.1 System

5.1.1 IO BIT

The system display shows the BIT relating to the CPUPak-4 system.

Group	Alert	Fault colour	Description
Input Systems	NovAtel GNSS	RED	The status of the NovAtel GNSS receiver. If an alarm is raised for the NovAtel receiver check under NovAtel for other fault alarms.
	Rockwell GNSS	RED	The status of the Rockwell GNSS receiver. If an alarm is raised for the Rockwell receiver, check for other faults under Rockwell and ensure that the receiver is connected.
	Heading System	RED	The status of the Heading unit. In the event of an alarm ensure that the unit is connected and powered on.
	Pitch/ Roll System	RED	The condition of the pitch and roll sensor. In the event of an alarm ensure that the unit is connected and powered on
Storage System	Log Drive Space Low	AMBER	In the event of an alarm: The remaining disk capacity has dropped below the user set value on the D drive. It will stop recording data. The threshold may be modified through the Alarm Thresholds menu.
	Log Drive Failure (Full?)	RED	The D drive may be full or there is a fault and the data logging has ceased.
	Storage Disk Out	AMBER	Drive D (compact flash) has been removed
Output Systems	DNAV Failure	RED	A DNAV fault will occur if the software does not have sufficient data to create a DNAV output. If a DNAV alarm is raised then check other peripheral alarm states to help find the fault.
	NMEA Failure	RED	An NMEA fault will occur if the software does not have sufficient data to create a NMEA output. If an NMEA alarm is raised then check other peripheral alarm states to help find the fault.

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5.1.2 NovAtel

This display shows the BIT information for the NovAtel receiver. The information is broken down into two groups, Receiver Status and Receiver Errors, both of which can be accessed from the tabs at the top of the display.

All “Reserved” fields have been added to the system to allow for future upgrades to the system.

Group	Alert	Fault colour	Description
Status	Receiver error	RED	This alarm indicates a fault with the NovAtel receiver. Try to reset the receiver using the reset function, and power cycling the system. If this fails report to the maintenance authority.
	Temperature	AMBER	It is either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority.
	Voltage	AMBER	The voltage being supplied to the receiver. The voltage should be between 9 and 15VDC and is typically around 12VDC. Anything above or below these values will trigger an alarm state.
	Ant. Power’d	AMBER	If an antenna powered alarm is raised check the **Antenna Open or Shorted** alarm is not set, or check that the **Internal or External LNA Voltage** alarm is not set. The first warning would suggest a cable failure most commonly, while the second warning would suggest an antenna power supply failure either on the receiver card or within the antenna. You can also manually check that the center core of the antenna cable has 5VDC on it, by using a voltmeter with ground, to the outside of the TNC connector and positive to the inner core. If this gives a reading between 4 and 18 VDC then the antenna should work. Check the antenna connectors and if OK it suggests there may be an antenna failure.
	Ant. Open	AMBER	It is either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This fault suggests an antenna cable failure or disconnection. Assuming the antenna cable is damaged, cut out the damaged section (as short a section as possible in order gain losses are not jeopardised) and reconnect with TNC connectors or similar.
	Ant. Shorted	AMBER	

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			See ***Further Information: Antenna open or shorted information*** section for more detail
	CPU O/load	AMBER	This relates to the OEMV processor and is shown on the CPUPak-4 in the NAVPak-4RT display. It is either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. The actual value is monitored on the main display as "Idle Time" at the top right of the screen. The value here will most probably be between 40 and 50% - this means the OEMV processor has between 40 and 50% capacity left. See ***Further Information: CPU Overload information*** section for more detail
	COM1 O/run	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This is the most common reason for a CPU overload alarm. As the NAVPak-4 software is preset to certain operating parameters, this condition should never arise, but a reported condition is due to the com ports being unable to transmit or receive data at the pre-programmed rates causing the com port FIFO (first in – first out) buffers to overflow. Restarting the CPUPak-4 may clear the problem. *Any buffer overruns are almost certainly caused by outside intervention through COM1* See ***Further Information: COM port over-runs information*** section for more detail.
	COM2 O/run	AMBER	
	COM3 O/run	AMBER	
	USB O/run	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. Restarting the CPUPak-4 may clear the problem.
	RF1 AGC	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority.
	RF2 AGC	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority.
	Almanac	AMBER	A fault will be reported when the almanac data is out of date.
	Pos Solution	RED	Position solution. This is either set to "good" or "bad". This may happen for a short period of time if the

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			antenna has been “wooded” from satellite signals or at start-up when satellites are acquired. Bad is a failure state if it continues at Amber level, and should be reported to the maintenance authority. However, look at the antenna cable installation for recent damage by chafing, cutting, etc… or equally likely, the TNC connectors at the antenna, or the CPUPak-4 connector panel. Excessive antenna vibration can also cause this state.
	Pos Fixed	AMBER	A fault in this alarm will indicate that the position of the receiver has been fixed. If the position is fixed it will not update and therefore will not match the actual position. Restarting the CPUPak-4 may clear the problem.
	Clk Steering	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority.
	Clock Model	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority.
	Ext Oscillator	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn’t affect the running of the CPUPak-4 and NAVPak-4.
	Software Res.	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority.
	Aux3 Status	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn’t affect the running of the CPUPak-4 and NAVPak-4.
	Aux2 Status	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn’t affect the running of the CPUPak-4 and NAVPak-4.
	Aux1 Status	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn’t affect the running of the CPUPak-4 and NAVPak-4.
Errors	DRAM	RED	Dynamic Random Access Memory. A failure is amber and this is probably terminal. It may be associated with many other warnings such as DNAV failure and Position Solution Invalid. There is no fix except for a repair to the OEMV board.

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	Invalid Firmware	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	ROM	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	ESN Access	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	Auth Code	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	Slow ADC	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	Supply V.	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	Thermometer	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	Temperature	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	MINOS5	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	PLL RF1 L1	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	PLL RF2 L2	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	RF1 H/W L1	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance

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			authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	RF2 H/W L2	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	NVM	AMBER	Non-volatile memory status is shown. It is either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This condition is not system critical, due to the way the CPUPak-4 receiver has been designed. Non-Volatile Memory holds current almanac data, ephemeris data, last known position and other related information. This will all be re-entered anyway upon start-up, which may take several minutes with an NVM failure as current almanac data is downloaded from the first acquired satellites rather than from NVM and takes up to 12 minutes.
	Software Resource	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	Model not valid	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	Remote Loading	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	Export Restriction	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.
	Component H/W	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This shouldn't affect the running of the CPUPak-4 and NAVPak-4.

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5.1.3 Rockwell

This display shows the BIT information for the Rockwell receiver.

Group	Alert	Fault colour	Description
Rockwell GNSS	Receiver Failure	RED	Either set to Good or Bad. Bad is a red failure state and should be reported to the maintenance authority.
	UTC Time unavailable	RED	Either set to Good or Bad. Bad is a red failure state and should be reported to the maintenance authority.
	Invalid Almanac	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. This can be caused if the almanac data stored in the receiver is out of date and cannot be used by the receiver,
	Time reference is not UTC	RED	Either set to Good or Bad. Bad is a red failure state and should be reported to the maintenance authority. Time has been set to another time reference. In the event of this occurrence, reset the unit using the Reset Rockwell feature. If the fault persists manually enter the Rockwell menu using the receivers keypad to adjust the settings. This should only be done by an expert user.
	Ground Speed is not Knots	RED	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. Ground Speed has been set to different units than knots. In the event of this occurrence, reset the unit using the Reset Rockwell feature. If the fault persists manually enter the Rockwell menu using the receivers keypad to adjust the settings. This should only be done by an expert user.
	Track units are not Degrees	RED	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. The Track data has been set to different units than Degrees. In the event of this occurrence, reset the unit using the Reset Rockwell feature. If the fault persists manually enter the Rockwell menu using the receivers keypad to adjust the settings. This should only be done by an expert user.
	North Reference is not true	RED	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. The reference for North is not reading as true. In the event of this occurrence, reset the unit using the Reset Rockwell feature. If the fault persists manually enter the Rockwell menu using the receivers keypad to adjust the settings. This should only be

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			done by an expert user.
	EHE Units are not meters	RED	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. The EHE output is not set to meters. In the event of this occurrence, reset the unit using the Reset Rockwell feature. If the fault persists manually enter the Rockwell menu using the receivers keypad to adjust the settings. This should only be done by an expert user.
	Position Solution Invalid	RED	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. In the event of this occurrence, reset the unit using the Reset Rockwell feature. If the fault persists manually enter the Rockwell menu using the receivers keypad to adjust the settings. This should only be done by an expert user.
	Internal Antenna Only	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. The Rockwell receiver is using its internal antenna and not the required external antenna. Check the connections to the external antenna to ensure that the cable or connections are not damaged.
	Datum is not WGS84	RED	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority. The position has been configured to another datum. In the event of this occurrence, reset the unit using the Reset Rockwell feature. If the fault persists manually enter the Rockwell menu using the receivers keypad to adjust the settings. This should only be done by an expert user.
Rockwell GNSS (SA/A-S)	Unauthorized	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority.
	Keyed, but not for today	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority.
	Keyed but failed CV verification	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority.
	Keyed: waiting for SV data	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority.
	Zeroized	AMBER	Either set to Good or Bad. Bad is an amber failure state and should be reported to the maintenance authority.

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5.1.4 Info

5.1.4.1 CPUPak-4 Info

This display shows the information relating to the CPUPak-4, NovAtel GNSS receiver and Rockwell GPS receiver.

Group	Alert/ Information	Fault colour	Description
CPUPak-4	Internal antenna	AMBER	This is either true or false and depends on whether the value sits between the thresholds. False is shown in amber.
	CPU Core Voltage	AMBER	This is either true or false and depends on whether the value sits between the thresholds. False is shown in amber.
	RF Deck Supply Voltage	AMBER	This is either true or false and depends on whether the value sits between the thresholds. False is shown in amber.
	Int. LNA Voltage	AMBER	This is either true or false and depends on whether the value sits between the thresholds. False is shown in amber.
	Ext. LNA Voltage	AMBER	This is either true or false and depends on whether the value sits between the thresholds. False is shown in amber.
	General Purpose IO	AMBER	This is either true or false and depends on whether the value sits between the thresholds. False is shown in amber.

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5.1.4.2 NovAtel Info

This version of NAVPak-4RT introduces BIT information for the OmniSTAR correction signal. When OmniSTAR corrections are being applied this panel will provide further information into the OmniSTAR signal.

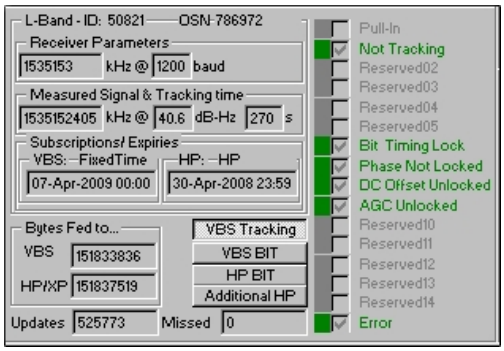

Figure 23 OmniSTAR BIT

Group	Alert/ Information	Fault colour	Description
NovAtel Info	Signal BIT	AMBER	Provides BIT information on the OmniSTAR signal and the status.
	VBS BIT	AMBER	Provides VBS information
	HP BIT	AMBER	Provides BIT information on the OmniSTAR HP signal and the status.
	Additional HP	AMBER	Additional HP information

This information has been provided to allow quick fault finding with Fugro/ OmniSTAR in the event of a fault with the corrections signal.

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5.2 GNSS Quality

This display shows the quality of the GNSS signal being received by the NovAtel and Rockwell receiver.

Group	Alert	Fault Colour	Description
NovAtel	Clock/ Time	AMBER	The clock/ time is either set to Good or Bad. Bad is an amber state and reflects that the internal receiver clock has failed or been disabled. Bad is a failure state and should be reported to the maintenance authority. If recycling the power or re-starting NAVPak-4 does not fix the problem then it is almost certainly a TCXO failure on the OEMV board.
	<= 3 Satellites	AMBER	Satellite observations are below 3. This value is either true or false. True highlights in amber.
	<= 5 Satellites	AMBER	Satellite observations are below 5. This value is either true or false. True highlights in amber.
	<4 L1 Ranges	AMBER	Number of tracked L1 Ranges is below 4. This value is either true or false. True highlights in amber. If it is true, the position will not be over-determined and other errors may occur such as “Position Solution Invalid.”
	<4 L2 Ranges	AMBER	Number of tracked L2 Ranges is below 4. This value is either true or false. True highlights in amber. If it is true, the position will not be over-determined and other errors may occur such as “Position Solution Invalid.”
	Soln Age >2x	AMBER	This value is either true or false. True highlights in red as it could cause an output failure. This label refers to the age of the computed position in seconds i.e. how long it is since the measurements were taken from the satellites that the displayed position was computed. For example times equal, or in excess of two seconds, (twice the default fix interval) trigger an amber level alarm in this case of positioning at 1Hz. If this fault is raised, look at the antenna cable installation for recent damage by chafing, cutting, etc… or equally likely, the TNC connectors at the antenna, or the CPUPak-4 connector panel. Excessive antenna vibration can also cause this state.
	C/ N0 Ratio	AMBER	This is a figure measured in dB-Hz relating the satellite signal strength, to the background noise. It is displayed on the main NAVPak-4RT display for each received satellites L1 frequency. Data for both L1 and L2 (if available) is stored in the logged data. L1 GPS figures should be within the bracket 45-51 to get best results. Low figures will be experienced when interference (jamming) is present, while high figures may be seen

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			when “spoofing” is present. Intermittent jumps in the figure for single observations or short periods may suggest multi-path and intermittent jamming and/or spoofing. Value is either true or false with respect to the paragraph above. True highlights in amber.
	L1 Jammed	AMBER	Reserved for future use
	L2 Jammed	AMBER	Reserved for future use
	DGPS age > LLs	AMBER	This value is either true or false. True highlights in amber. It gives the time in seconds since the last differential correction, used in the positioning process was received at the CPUPak-4. When using OmniSTAR corrections, check the System>Info> NovAtel Panel for an indication to a fault in the OmniSTAR signal. See ***Further Information: DGPS age information*** section for more detail.
	DGPS age > ULs	RED	If the alarm is set, consideration should be given to disabling the DGPS corrections as being potentially worse than no corrections at all. A look at the HAA values will confirm the need for this. When using OmniSTAR corrections, check the System>Info> NovAtel Panel for an indication to a fault in the OmniSTAR signal.
	L1 psr.sd > 1.0m	AMBER	L1 pseudorange standard deviation is greater than 1.00 meter. This value is either true or false. True highlights in amber. These are statistically derived qualitative measurements of the estimated errors in range measurements and carrier phase cycle counts. They are computed as single state standard deviations. Levels greater than those stated suggest the GPS signal is not of the best quality due to some environmental condition which may just be low elevation. Check HAA and error ellipse values to see if this is important. This value is most useful for tracking data quality at base station sites and in open sky environments. Don’t pay too much attention to this field if the GPS is fitted to a vehicle as the values will be skewed if satellites are constantly in and out of view e.g. behind trees, buildings, bridges, etc…
	L2 psr.sd > 1.0m	AMBER	– See above
	L2 cp.sd >	AMBER	– See above

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	0.04m		
	L2 cp.sd > 0.06m	AMBER	– See above
Rockwell	Clock/ Time	AMBER	The clock/ time is either set to Good or Bad. Bad is an amber state and reflects that the internal receiver clock has failed or been disabled. Bad is a failure state and should be reported to the maintenance authority. If recycling the power or re-starting NAVPak-4 does not fix the problem then it is almost certainly a TCXO failure on the board.
	<= 3 Satellites	AMBER	This value is either true or false. True highlights in amber.
	<= 5 Satellites	AMBER	This value is either true or false. True highlights in amber
	<4 L1 Ranges	AMBER	This value is either true or false. True highlights in amber. If it is true, the position will not be over-determined and other errors may occur such as "Position Solution Invalid."
	<4 L2 Ranges	AMBER	This value is either true or false. True highlights in amber.
	Soln Age >2x	AMBER	This value is either true or false. True highlights in amber. However this could result in an output navigation message failure, which will highlight in red. If secondary navigation or dead-reckoning devices are incorporated then this will be the time at which they may cut in if set to switch as a default setting. This label refers to the age of the computed position in seconds i.e. how long it is since the measurements were taken from the satellites that the displayed position was computed. For example times equal, or in excess of two seconds, (twice the default fix interval) trigger an amber level alarm in this case of positioning at 1Hz.
	C/ N0 Ratio	AMBER	Value is either true or false with respect to the paragraph below. True highlights in amber. This is a figure measured in dB-Hz relating the satellite signal strength, to the background noise. It is displayed on the main NAVPak-4RT display for each received satellites L1 frequency. Data for both L1 and L2 (if available) is stored in the logged data. L1 GPS figures should be within the bracket 40-50 to get best results. Low figures will be experienced when interference (jamming) is present, while high figures may be seen when "spoofing" is present. Intermittent jumps in the figure for single observations or short periods may suggest multi-path and intermittent jamming and/or spoofing.

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	L1 Jammed	AMBER	Reserved for future use
	L2 Jammed	AMBER	Reserved for future use
	DGPS age > LL	AMBER	This value is either true or false. True highlights in amber. It gives the time in seconds since the last differential correction, used in the positioning process was received at the CPUPak-4. See ***DGPS age information*** section for more detail.
	DGPS > UL	RED	If alarm is raised, consideration should be given to disabling the DGPS corrections as being potentially worse than no corrections at all. A look at the HAA values will confirm the need for this.
	L1 psr.sd > 1.0m	AMBER	This value is either true or false. True highlights in amber. These are statistically derived qualitative measurements of the estimated errors in range measurements and carrier phase cycle counts. They are computed as single state standard deviations. Levels greater than those stated suggest the GPS signal is not of the best quality due to some environmental condition which may just be low elevation. Check HAA and error ellipse values to see if this is important. This value is most useful for tracking data quality at base station sites and in open sky environments. Don't pay too much attention to this field if the GPS is fitted to a vehicle as the values will be skewed if satellites are constantly in and out of view e.g. behind trees, buildings, bridges, etc…
	L2 psr.sd > 1.0m	AMBER	– See above
	L2 cp.sd > 0.04m	AMBER	– See above
	L2 cp.sd > 0.06m	AMBER	– See above

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5.3 Position

This display shows the quality of position from the NovAtel and Rockwell receivers.

Group	Alert	Fault Colour	Description
NovAtel	HAA > 5m	AMBER	This value is either true or false. True highlights in amber. The HAA is the Horizontal Accuracy Assessment and will only highlight if the computed HAA is higher than 5 metres. HAA is a 95% probability level figure.
	HAA > 10m	RED	This value is either true or false. True highlights in red. The HAA is the Horizontal Accuracy Assessment and will only highlight if the computed HAA is higher than 10 metres.
	f-test > Xm	AMBER	The suggested default value is twenty-five at which level the warning alarm will trigger indicating over-eccentricity of the error ellipse.
	w-test > Xm	AMBER	The suggested default value is seven point five metres.
	Smjr Err > Xm	AMBER	The suggested default value is five metres.
Rockwell	HAA > 5m	AMBER	The horizontal accuracy assessment is greater than 5 meters. This value is either true or false. True highlights in amber. The HAA is the Horizontal Accuracy Assessment and will only highlight if the computed HAA is higher than 5 metres. HAA is a 95% probability level figure.
	HAA > 10m	RED	The horizontal accuracy assessment is greater than 10 meters. This value is either true or false. True highlights in amber. The HAA is the Horizontal Accuracy Assessment and will only highlight if the computed HAA is higher than 10 metres.
	f-test > Xm	AMBER	Due to the Rockwell receiver's output of identical SD values for both latitude and longitude this test is invalid
	w-test > Xm	AMBER	The suggested default value is seven point five metres.
	Smjr Err > Xm	AMBER	The suggested default value is five metres.
Output System	DNAV HAA Warning	AMBER	This value is either true or false. True highlights in amber. The HAA is the Horizontal Accuracy Assessment and will only highlight if the computed HAA is higher than 5 metres. HAA is a 95% probability level figure.
	DNAV HAA Alert	RED	This value is either true or false. True highlights in red. The HAA is the Horizontal Accuracy Assessment and will only highlight if the computed HAA is higher than 10 metres.

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6 Further Information

6.1 Overview

The following section provides more information on various system states and alarms.

6.2 COM port over-runs information

On the CPUPak-4 system (if used) there is one external GPS port available for monitoring and maintenance. This is COM1 of the OEMV GPS and it may report an overflow depending on what the COM port is being asked to transmit and receive. If the CPUPak-4 is operational as this occurs performance will be jeopardized as the onboard processor may treat the COM port as a priority activity. Careful reading of the NovAtel Vol 2 Users' Guide in conjunction with the messages you are sending and receiving will allow the operator to define a sensible flow rate. The external COM1 port of CPUPak-4 has default settings of 115200 kbaud and is explained fully in the CPUPak-4 Operators' Manual.

Note: Other COM ports can be programmed through COM1 and could report a buffer over-run. Normally power-cycling the CPUPak-4 should clear this problem and reset the unit to it's default state.

You can perform a simple calculation in a few minutes should you wish to verify the baud rate throughput your messages require on AUX GPS by the following method:

Count the number of characters (CH) to be output in the message (Vol. 2 Users' Guide) including symbols, punctuation, spaces, etc… for the whole message.
Multiply the number of characters (CH) by ten (10 – one start bit, eight data bits, one stop bit) to get the number of bits in the message (CH x 10).
Take the frequency of the message e.g. 2 if the message is transmitted twice a second and multiply it by the number of bits at b) above (CH x 10 x 2).
Take the product of c) above ensuring it does not exceed the 115200 baud rate (bits/sec). See the example below for a better operational understanding and how best to use baud rate throughput.

Example:

CH = 300
Bits/CH = 10
Message output rate = 20Hz
Throughput baud rate = 300 x 10 x 20 = 60,000 bits/sec
Baud rate set = 115,200 bits/sec
Throughput baud rate as a % of maximum = (60,000/115,200) x 100 = 52.08%

This would be a safe throughput rate for all the messages. Remember if you output more than one message, each must be computed in the same style and the results added together to get the total baud rate throughput, i.e. two messages of 150 characters each would be the equivalent of one message with 300 characters in it. Problems may start to occur with data latency and integrity once a baud rate throughput level equivalent to 60% of the baud rate is reached. Be

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aware that the upper baud rate limit on the AUX GPS Com port is 921,600 baud and this can be easily reset temporarily. Finally, note that there is an 8Kb data buffer on the AUX GPS Com port where data already prepared for transmission can be queued for release when the baud rate allows. The time of buffered data measurement will not be changed but it just might take a fraction of a second to be released from the COM port.

The standard CPUPak-4 and NAVPak-4 settings ensure that there are no COM port overflow messages on the system. If any occur on COM2 or COM3 then shutting down the CPUPak-4 system and re-starting will clear them. If there are no other faults on the system a COM2 or COM3 buffer overrun will be due to operator changes made to the configuration. If they occur on COM1 either use the command “UNLOGALL COM1” through COM1 from a remote terminal or use the same procedure as for re-setting COM2 and COM3. Never use the UNLOG COM2, UNLOG COM3 or UNLOGALL commands as this will stop NAVPak-4 working and require a restart of the application software.

Any buffer overruns are almost certainly caused by outside intervention through COM1

6.3 CPU Overload

This relates to the OEMV processor and is shown on the CPUPak-4 in the NAVPak-4RT display. It is either set to good or bad. Bad is an amber failure state and should be reported to the maintenance authority.

The actual value is monitored on the main display as “Idle Time” at the top right of the screen. The value here will most probably be between 40 and 50% - this means the OEMV processor has between 40 and 50% capacity left.

The prime numbers for this value are 40% or higher. Problems may be encountered with some operations at values of 25% or less. In the event this value drops below 20% ensure there are no alarm conditions on the display that need investigating. Typical design figures for the CPUPak-4 and NAVPak-4 software combination are 45% or higher, at maximum design computation and logging rates. The NAVPak-4’s BIT (Built In Test) will help determine many of the issues that are causing this idle time value to be low. Avoid COM2 with raw IMU measurement data and do not combine raw IMU measurements and processed INS data on the same COM port.

The other CPU is in the optional CPUPak-4 and normally runs at 70 to 80% capacity left. Use Windows Task Manager to determine this, which uses about 10% of the available processor power on a 133 MHz unit.

6.4 Antenna Open or Shorted information

A common fault is water in the cable from the antenna TNC connector. Examine closely the sealant around the antenna TNC connector, and cut back, and replace if necessary. On rare occasions water may get inside some antenna housings. To assess this remove the antenna and listen for water “sloshing” around inside.

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Examine for hairline cracks, and if this is the fault you may just require a “get you home” repair, by carefully removing the antenna TNC connector, washing the antenna out with distilled water, drying thoroughly in an oven, and resealing with silicon sealant / grease and tape. The most effective temporary repair would be using high impact adhesive, with the antenna housing cleaned thoroughly, in the affected area.

Remember constant heating and cooling (sun and shade), of the antenna, will cause the air inside to act like a pump through any hairline crack, so take care not to strike the antenna housing with any object. If struck, examine the housing for hairline cracks and take preventative action if necessary.

6.5 DGPS age information

The default alarm settings for the NAVPak-4 software running on the CPUPak-4 are recommended as twenty and forty seconds, for use with the OmniSTAR or SeaSTAR VBS service. Exceeding either of these limits will result in an amber warning on the CPUPak-4 screen that will generate an alarm report and if a screen is present it may require operator interaction to clear the alarm.

If a local DGPS service is used, then consideration could be given to changing these values, and in particular, with RTK corrections where this receiver can accept alarm levels of five and ten seconds which may be a more judicious choice.

With Selective Availability (SA) currently off, then ages of differential corrections in the order of forty seconds are not going to cause a great loss in positional accuracy. The NovAtel OEMV LB receiver will discontinue use of the last set of DGPS corrections received after three hundred (300) seconds.

With SA currently disabled, DGPS correction update rates do not have to be particularly fast to achieve good quality positions. Accordingly occasional delays of up to thirty seconds in between corrections will probably not have detrimental affects. Normally times of five to fifteen seconds are achieved with OmniSTAR / SeaSTAR VBS service

However, even without differential corrections, the NovAtel OEMV receiver can use both frequencies, L1 and L2, to compute local atmospheric, tropospheric and ionospheric corrections (if L2 is available); some of the largest error sources in the DGPS corrections. Accordingly it may be sensible to remain with the OEMV LB receiver as primary navaid even if alternative navigation is available.

6.6 Ephemeris, Raw Range and Carrier Phase Related Information

All of this data is exclusive to the NovAtel OEMV and not supplied by the Rockwell GPS receiver. With the correct software (not supplied) this data can be used to post-process real-time computed positions for a direct comparison and QA/QC of navigational quality. This data can be used for re-computation of the navigational data at System Administrator set logged data intervals for the elimination of operational gross(blunders), systematic and random errors. This navigation data could then be re-inserted into new DNAV messages for the MW or Survey Database.

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6.6.1 Satellites used for computation

This data is identical to that described in the “Number of Satellite Observations used in the Position” for the “Position Related Information” described previously.

6.6.2 Other Satellites Available

This data gives a specific tally of satellite L1 and L2 data that was not used for a number of reasons. Those reasons include but are not limited to low elevation (below the elevation cutoff angle set to eight degrees), recently acquired but noisy data, bad data due to intermittent interference which may be physical obstruction of the satellite or simply signal interference. This data although rejected from the position computation is still logged in the NovAtel messages.

6.6.3 L1 and L2 Ranges and Carrier Phase Data for all Visible Satellites

This data is stored in the NovAtel OEMV message logs and gives sufficient data to generate actual measured pseudoranges and carrier phase cycle counts from each satellite for L1 and L2, where available, to the GPS antenna.

6.6.4 Standard Deviations for Pseudoranges and Carrier Phase Measurements

These are statistically derived qualitative measurements of the estimated errors in range measurements and carrier phase cycle counts. They are computed as single state standard deviations.

6.6.5 Satellite Lock Duration since Acquisition

This is the time in seconds since the NovAtel receiver acquired lock on a satellite’s L1 or L2 signal and in the case of OmniSTAR’s VBS that signal too. Values of ten seconds or less will provide noisy L1 and L2 GPS data that can result in a worsening of positional accuracy. In the case of the VBS signal that does not require carrier phase tracking to get the broadcast signal then the recovery times are shorter. For a ship these values should anyway be continuous times from when the satellite rose above the horizon to when it sets below the horizon and might be as large as 21600 seconds (6 hours). For a geostationary satellite the figures will ideally be continuous from switch-on to switch-off

If at any time the antenna-satellite path is blocked by anything that is not satellite signal transparent then this time will reset to zero and start recounting upwards. Occasional resets will not unduly affect positional accuracy but continual resets e.g. every ten seconds or less could cause the receiver to go into a general reset and sky search for satellites’ L1 and L2 signals. Objects that are not radio transparent could be wet signal flags, halyards, masts, funnels, parts of the body, leafy foliage, etc… Rain, snow, clouds and fog are not going to cut out the satellite signal. Finally one should not forget that radio interference on the L1 (1575.42 +/-10MHz) and L2 (1227 +/- 10MHz) and OmniSTAR VBS (~1543 +/-23MHz) could well affect the satellite lock duration. Non-malicious sources of interference can include navigation radars (in particular old Japanese models), cell phone networks (again Japanese), satellite communication transmitters and other in-band or harmonic transmitters. The NovAtel receiver is fairly tolerant of these noise sources due to them being largely engineered out in the receiver and antenna electronics and firmware. In particular, the Pulse Aperture Correlation techniques raise the in band interference tolerance levels above those previously tolerated by any GPS receivers.

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Note that if for any reason the GPS antenna is re-sited in an attempt to improve lock times then ensure the lever arm offsets are updated in the System Administrator section of the NAVPak4 RT software

6.6.6 Carrier to Noise Density Ratio

This is a figure measured in dB Hz relating the satellite signal strength to the background noise. It is displayed on the main NAVPak4 RT display for each received satellite's L1 frequency. Data for both L1 and L2 is stored in the logged data. Figures should be within the bracket 40-50 to get best results. Low figures will be experienced when interference (jamming) is present while high figures may be seen when "spoofing" is present. Intermittent jumps in the figure for single observations or short periods may suggest multi-path and intermittent jamming and/or spoofing.

Please note that the signal to noise ratios on the NovAtel OEMV receiver are logged and displayed after the receivers automatic gain control functions have done their work. Consequently they are not a representation of the ambient GPS signals with relation to the background radio noise but they represent the on-board post gain adjustment figures. In reality the figures that matter are post gain control for position processing.

6.6.7 Instantaneous Doppler Frequency

This data is logged for all satellites being tracked whatever the standard of the signal. This Doppler frequency will almost certainly be different for all satellites but there should be correlation for any single satellite's L1 and L2 signals.

The Doppler frequency is the shift from the satellite's central transmitting frequency caused by relative motion of satellite and vessel antenna. The satellite's orbital movement at about 6500 mph normally causes by far the largest part of this frequency shift. However, when a satellite approaches overhead the Doppler shift will reduce towards zero.

The Doppler frequencies are used by the NovAtel OEMV receiver to compute vessel velocity normally to an accuracy of <0.1m/sec RMS in DGPS mode or <0.02m/sec RMS in RTK mode (requires upgrade in your model). In the event of Inertial Navigation integration these instantaneous Doppler frequencies are essential for loose or tight coupling.

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